

MONITORING PROGRAM ANNUAL REPORT

JANUARY - DECEMBER 2000

ANCHORAGE WATER AND WASTEWATER UTILITY POINT WORONZOF WASTEWATER TREATMENT FACILITY



Prepared for:



MUNICIPALITY OF ANCHORAGE
Anchorage Water & Wastewater Utility
Anchorage, Alaska

Prepared by:



KINETIC
LABORATORIES
INCORPORATED

with contract administration and technical review by:

CHM HILL

February 2001

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NPDES Permit AK-002255-1

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PREFACE

This document is the Monitoring Program Annual Report required for submittal to the Environmental Protection Agency by NPDES Permit AK-002255-1 for discharge from the John M. Asplund Water Pollution Control Facility, operated by the Municipality of Anchorage at Point Woronzof. The NPDES permit incorporates provisions necessitated by a 301(h) waiver from the requirements of secondary treatment.

The elements of the Monitoring Program are:

- Influent, Effluent, and Sludge Monitoring
 - In-Plant Sampling
 - Toxic Pollutant and Pesticide Sampling
 - Pretreatment Monitoring
 - Whole Effluent Toxicity Monitoring
- Receiving Water Quality Monitoring
 - Plume Dispersion
 - Intertidal Zone Bacteria
- Sediment and Bioaccumulation Monitoring
 - Sediment Analyses
 - Bioaccumulation Analyses

During 2000, the program consisted of sampling the influent, effluent, and sludge twice for toxic pollutants and pesticides and one receiving water quality sampling. In addition, the Municipality of Anchorage conducted the required self-monitoring program for the influent, effluent, and sludge. No sediment or bioaccumulation sampling was conducted during 2000.

This annual report provides information concerning the first year of the monitoring program performed to meet the requirements as set forth in the new NPDES permit that was signed on 30 June 2000 and became effective on 2 August 2000. The report covers the period of 1 January through 30 December 2000.

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- A1 AWWU
 Metals, Oil & Grease and Cyanide
- A2 ToxScan
 Metals, Pesticides, Hydrocarbons
- A3 Severn Trent
 Priority Pollutants
- A4 SES
 Asbestos Data

APPENDIX B Toxic Pollutant and Pesticide Monitoring Data, August Sampling

- B1 AWWU
 Metals, Oil & Grease and Cyanide
- B2 ToxScan
 Metals, Pesticides, Hydrocarbons
- B3 Severn Trent
 Priority Pollutants
- B4 SES
 Asbestos Data

APPENDIX C Whole Effluent Toxicity Testing

- C1 ToxScan
 Third Quarter Test
- C2 ToxScan
 Fourth Quarter Test

APPENDIX D Receiving Water Quality Monitoring

- D1 ToxScan
 Hydrocarbons, TSS and Cyanide
- D2 Battelle
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- D3 Northern Testing Laboratories
 Intertidal Bacteria, TRC and Color
- D4 Kinnetic Laboratories, Inc.
 Salinity, DO, and Turbidity
- D5 Hydrographic Data Profiles
- D6 Field Data Sheets

SUMMARY

PURPOSE

This report is submitted in response to requirements of the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) as outlined in the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1 that was signed on 30 June 2000 and became effective on 2 August 2000. This permit authorizes discharge of effluent from the John M. Asplund (Point Woronzof) Water Pollution Control Facility. Wastewater from the Municipality of Anchorage (MOA) is treated at this facility before discharge to the receiving waters of Knik Arm in Cook Inlet, Alaska. The NPDES permit incorporates the requirements necessitated by a 301(h) waiver from secondary treatment and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the Clean Water Act (CWA, 33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987, P.L. 100-4.

HISTORY

In September 1979, the MOA submitted to the EPA a 301(h) secondary treatment waiver application proposing an improved discharge which eliminated chlorination and required the addition of both a 610-meter (m) extension and a 305-m diffuser to the Point Woronzof outfall. The outfall extension was intended to move the point of discharge beyond the influence of a gyre that was reported to exist off Point Woronzof on a flood tide which was presumed to carry effluent toward shore, causing bacterial contamination of the shoreline.

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. The central issue was to evaluate outfall design alternatives and the chlorination/no chlorination option in relation to a system of eddies that occur on the flood tide. These studies were completed and presented as an *Amendment to the Wastewater Facilities Plan for Anchorage, Alaska* (CH2M Hill et al., 1985). This amended plan recommended the use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would be required to meet bacterial standards even with an extended outfall and diffuser. Because the same water quality standards could be met by chlorinating and installing an improved diffuser at the end of the existing outfall, there was no need to extend the outfall.

Concurrent with the studies to amend the facilities plan, a revised 301(h) waiver application was submitted to the EPA. After extensive EPA review, public comment, and hearings, the Final Permit Decision was issued and the five-year NPDES permit became effective 16 October 1985 (EPA, 1985a). The permit specifies the required monitoring program. As required by this permit, a multi-port diffuser was installed in August 1987 prior to the second year of receiving water sampling. Fourteen years of monitoring were performed under the initial NPDES permit.

The MOA submitted an application to renew the 301(h) waiver from secondary treatment in 1990. A more recent application was submitted in 1998 with additional information provided to EPA in 1999. A draft NPDES permit that incorporated the 301(h) waiver was issued in 1999 for public comment. The renewed permit was signed by EPA on 30 June 2000 to become effective on 2 August 2000. This five-year permit expires on 2 August 2005.

RECEIVING WATER ENVIRONMENT

The Point Woronzof facility discharges into Knik Arm, a unique body of estuarine water with extremely high tidal fluctuations (up to 11.6 meters [m] with a mean range of 7.89 m at Anchorage; NOAA/NOS, 1995). These fluctuations produce extensive tidal flats, swift tidal currents of 4-5 knots, and intense mixing within the Inlet. The water is almost a slurry because of the naturally high suspended sediment concentrations of up to 2500 milligrams/liter (mg/L). This sediment originates from glacial melt waters discharging into Cook Inlet.

Large temperature extremes occur between summer and winter. In the winter, ice can reach thicknesses of 1-2 m and consists of broken pieces due to the large tides and currents. Other important factors are the large volume of saline water present in Cook Inlet and mixing by tidal turbulence which allows this volume to be effective in wastewater dilution and assimilation.

MONITORING OBJECTIVES

The monitoring that was conducted during 2000 consisted of two main components: (1) in-plant monitoring of influent, effluent, and sludge, including whole effluent toxicity testing; and (2) receiving water quality monitoring in the vicinity of the discharge and at a control site across Knik Arm. Objectives of the 2000 program are summarized as follows:

2000 MONITORING OBJECTIVES

Influent, Effluent, and Sludge Monitoring

- determine compliance with the NPDES permit and State of Alaska water quality criteria
- determine effectiveness of the industrial pretreatment program
- aid in assessing the water quality at the discharge point
- characterize toxic substances
- help monitor plant performance
- determine compliance with the regulatory criteria of Section 301(h) of the CWA
- provide data for evaluating permit re-issuance

Water Quality

- determine compliance with the NPDES permit and State of Alaska water quality criteria
- aid in assessing the water quality at the discharge point
- determine compliance with the regulatory criteria of Section 301(h) for the CWA
- determine the level of bacterial contamination in nearshore waters
- provide data for evaluation re-issuance of this permit

MONITORING RESULTS

As part of its self-monitoring program, the Anchorage Water and Wastewater Utility (AWWU) conducted daily, weekly, and monthly sampling of influent, effluent, and sludge, depending on the parameter measured. In addition, monitoring for toxic pollutants and pesticides was conducted twice during 2000; once in June 2000 under the old permit and once in August 2000 under the new permit. Whole effluent toxicity testing was conducted twice during 2000 under the new permit. Water quality monitoring near the discharge was conducted once during August 2000 under the new permit.

All the data presented in this report were compared with the new 2000 permit limitations and requirements rather than the requirements of the 1985 permit which became obsolete on 1 August 2000. Data that were required under the old permit (January- July 2000) have already been reported to EPA by AWWU in monthly submittals, and any permit exceedances that may have occurred under the old permit were reported to EPA as required with the appropriate monthly report and have not been reiterated here.

The following summarizes results from this year of monitoring based on the 2000 permit requirements:

2000 MONITORING RESULTS

Influent, Effluent, and Sludge

- Met permit objectives and requirements and Alaska State water quality standards with the exception of only one parameter (fecal coliform). Results from parameters of particular concern are summarized below, including permit exceedances as noted.
- Fecal coliform exceeded the monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC MPN/100 mL during any month" during July and October 2000. However, the maximum geometric mean of 850 FC MPN/100 mL was never exceeded.
- Total aromatic hydrocarbon concentrations and total aqueous hydrocarbon concentrations measured in the effluent were below the maximum allowable effluent concentration (MAEC).
- Cyanide and metals concentrations in the effluent never exceeded their MAECs during any of 2000 monthly, pretreatment, or toxic pollutant samplings.
- MOA's self-monitoring of pH, total residual chlorine, biochemical oxygen demand (BOD₅), and total suspended solids showed compliance with the 2000 permit effluent limitations. The daily maximum for total residual chlorine in the effluent was never exceeded. Total suspended solids and BOD₅ were well within the daily, weekly, and monthly criteria for the entire reporting period. The percent removal rate for both total suspended solids and BOD₅ were well within required limits.
- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in influent and effluent were within the established range or lower than values from a national study of secondary treatment plants.

- Toxic pollutant sludge concentrations were within the established range or lower than values from a national study of secondary treatment plants.
- Whole effluent toxicity testing conducted on three species during the last two quarters of 2000 under the new permit met the permit limitations for chronic toxicity. The most sensitive species during these two test periods was shown to be the mussel *Mytilus galloprovincialis*.

Water Quality

- Little variation among stations was observed for most parameters.
- Receiving water and intertidal fecal coliform concentrations met the most restrictive State water quality criteria median of 14 MPN/100 mL for "harvesting for consumption of raw mollusks or other raw aquatic life". The criterion of the geometric mean not exceeding 20 MPN/100 mL was also met. In addition, the criterion of not more than 10% of the samples exceeding 40 MPN 100/mL was also met.
- Fecal coliform concentrations were statistically higher within the zone of initial dilution (ZID), at the ZID boundary, and at the nearfield stations as compared to the control stations. Higher values seen at some stations could not be directly attributed only to the Point Woronzof discharge as local creeks exhibited fecal coliform concentrations higher than most of the water quality and intertidal stations.
- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that background levels of dissolved metals were all below the new State site-specific water quality standards. Total recoverable metals were elevated compared to the dissolved, as expected, and this was attributed to high suspended sediment loads. No significant differences between the outfall and control stations were found for either dissolved or total recoverable metals. All cyanide concentrations were below detection limits.
- Total aqueous hydrocarbons and total aromatic hydrocarbons met the State's water quality standards at all stations. No significant differences were found between concentrations at the control and outfall stations for these hydrocarbons, which were all reported below method detection limits.
- Turbidity and total residual chlorine met the State water quality criteria at all stations. Color exceeded the State water quality criterion at a number of stations, including both outfall and control stations, and therefore this was not attributed to the outfall.

CONCLUSIONS

Results from this year of the monitoring program confirm previous studies, data in the 301(h) waiver application, and the decision by the EPA to reissue the permit. The Point Woronzof facility is operating within regulatory requirements with only one exception and with no significant impacts to the marine environment.

1.0 INTRODUCTION

1.1 REGULATORY/ENVIRONMENTAL BACKGROUND

The Point Woronzof Monitoring Program is designed to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit AK-002255-1 which authorizes discharge of municipal effluent into the Knik Arm of Cook Inlet receiving waters from the John M. Asplund Water Pollution Control Facility, operated by the Municipality of Anchorage (MOA), Figure 1. The NPDES permit, which became effective on 2 August 2000, incorporates the requirements necessitated by a 301(h) secondary treatment waiver and is in compliance with provisions of the Federal Water Pollution Control Act as amended by the Clean Water Act (33 U.S.C. §1251 et seq.) and the Water Quality Act of 1987, P.L. 100-4.

1.1.1 Regulatory Background

In 1972, while the Point Woronzof treatment facility and outfall were being built for the MOA, the Federal Water Pollution Control Act (FWPCA) was amended to establish two phases of effluent limitations applicable to all Publicly Owned Treatment Works (POTWs). Under 301(b), POTWs were required to achieve secondary treatment of effluent by 1 July 1977 and the "best practicable waste treatment technology" by July 1983.

Congress again amended the FWPCA in 1977. Section 301(h) was added, providing that the Administrator of the EPA, upon application from a POTW and with the concurrence of the State, might issue an NPDES permit waiving the requirements of Section 301(b). On 15 June 1979, EPA promulgated the regulations regarding the issuance of this waiver of secondary treatment to an applicant discharging into certain ocean and estuarine waters and demonstrating compliance with the 301(h) criteria.

In September 1979, the MOA forwarded to the EPA a 301(h) waiver application proposing an improved discharge which eliminated chlorination and required the addition of both an extension and diffuser to the Point Woronzof outfall. Earlier studies had recommended the construction of a 610-m outfall extension and a 305-m diffuser. The proposed extension/diffuser reportedly could meet fecal coliform receiving water standards without chlorination and prevent shore contact of the wastewater plume.

As a parallel program, the MOA undertook preparation of a wastewater master plan for the Anchorage Bowl area. The resultant *Wastewater Facilities Plan for Anchorage, Alaska* (Ott Water Engineers, Inc. et al., 1982) and the *Environmental Impact Statement, City of Anchorage, Alaska, Wastewater Facilities* (EPA and Jones & Stokes, 1982) were accepted by the EPA and the Alaska Department of Environmental Conservation (ADEC).

Further studies were subsequently undertaken to derive design criteria for the outfall improvements. Significant efforts were included in this study to improve the reconnaissance level data upon which the outfall length and diffuser design were to be based and to evaluate bacterial standards applicable to Knik Arm. The central issue was to evaluate outfall design alternatives and the chlorination or no-chlorination option in relation to the presence of a system of eddies that occur to the east of Point Woronzof on the flood tide and that might be capable of transporting the effluent shoreward.

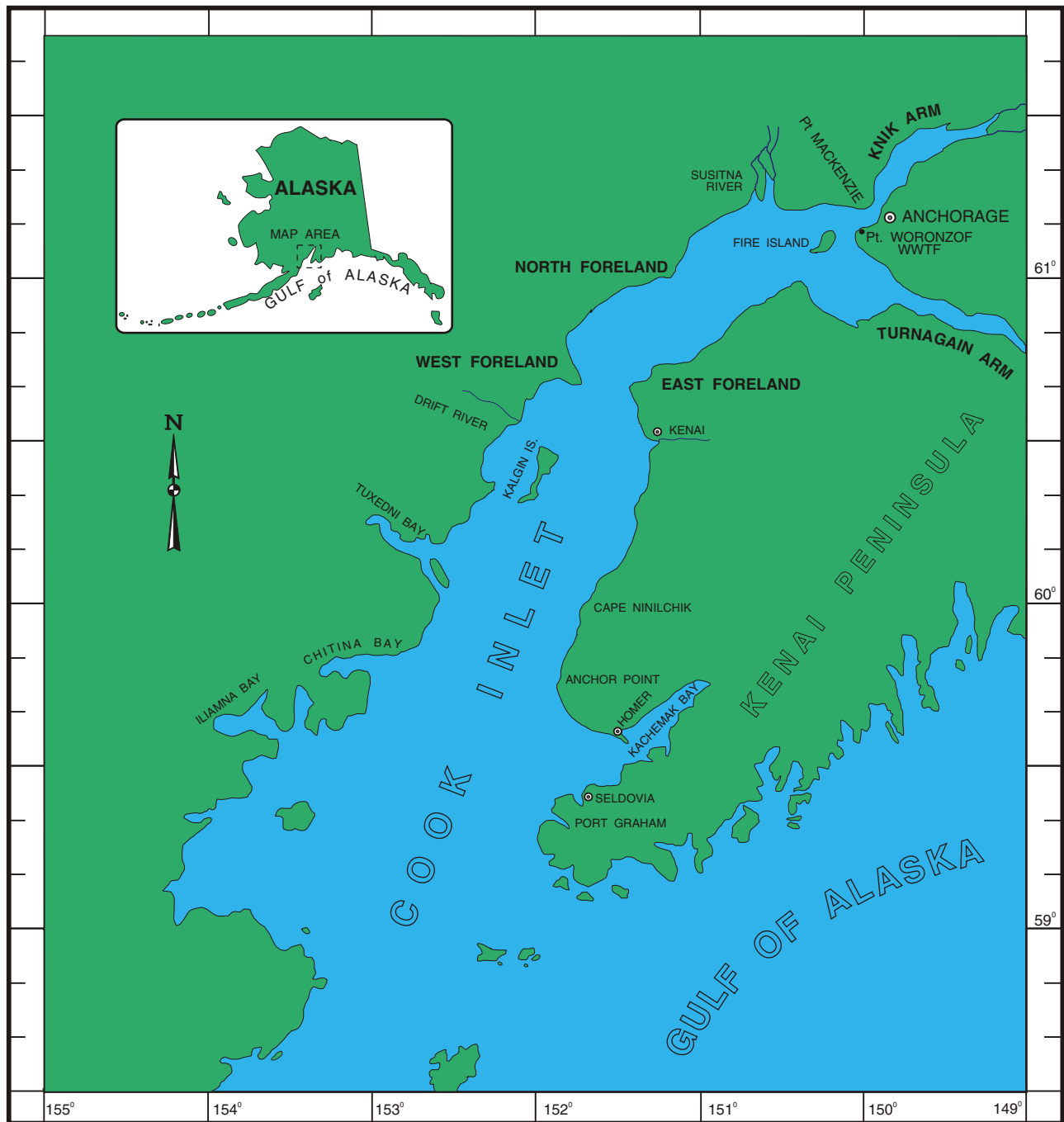


Figure 1. General Study Area.

These latter studies were completed and presented as an *Amendment to the Wastewater Facilities Plan for Anchorage, Alaska* (CH2M Hill et al., 1985). This amended plan recommended use of the existing 245-m outfall with the addition of a three-nozzle diffuser. It was shown that chlorination would be required to meet bacterial standards even with an extended outfall and diffuser. Because the same standards could be met by use of chlorination and the existing outfall, there was no need to extend the outfall. With continued chlorination, all water quality standards were predicted to be met by the amended plan.

Concurrent with the studies to amend the facilities plan, a revised application entitled *Application for Modification of Secondary Treatment Requirements, Section 301(h), Clean Water Act* was submitted to the EPA (CH2M Hill et al., 1984). The EPA Region 10 301(h) Review Team's Tentative Decision Document, entitled *Analysis of the Section 301(h), Secondary Treatment Variance Application for the John M. Asplund Water Pollution Control Facility* (EPA, 1985b), and a draft NPDES permit were made available for public comment on 17 January 1985. After comments and appropriate hearings, the Final Permit Decision (EPA, 1985a) was issued 13 September 1985, and the start date of the five-year NPDES Permit AK-002255-1 was listed as 16 October 1985. As required by this permit, a multi-port diffuser was installed at the Point Woronzof outfall in the beginning of August 1987. This occurred prior to the 1987 summer water quality monitoring program. This original NPDES permit expired on 15 October 1990.

The MOA submitted a renewal application for the permit in April 1990 which addressed amendments made to the 301(h) provisions by the Water Quality Act. That renewal application was not acted upon and the facility continued to operate under an administrative extension of the 1985 permit until August 2000. In 1998 it was projected that the growth of Anchorage would result in the discharge limits contained in the 1985 permit being exceeded within a few years. Therefore, the MOA prepared and submitted another renewal application which replaced the 1990 application in October 1998 (CH2M Hill, 1998.).

In tandem with the renewal application, the MOA conducted special studies and submitted a request for site-specific water quality criteria (SSWQC) to the ADEC for the Point Woronzof area of Cook Inlet in December 1998. This request for SSWQC was for turbidity and a suite of metals and was necessitated because the Alaska Water Quality Standards (AWQS) for marine waters could not be achieved for these waters as a result of the naturally high suspended sediment loads in Cook Inlet due to glacial inputs. The approach to the request was based on the EPA's recently promulgated Metals Policy which recommends the use of only the dissolved fraction of metals as bioavailable and appropriate for the protection of aquatic and associated beneficial uses of the water body. Following both agency and public review and comments, the SSWQC were incorporated into the AWQS as amended on 27 May 1999. The SSWQC for the Point Woronzof area included turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, silver, and zinc.

Following the promulgation of these new AWQS, a tentative decision to grant the MOA its 301(h) variance was made by EPA on 4 November 1999. The tentative decision, draft NPDES permit, and fact sheet were then made available for public review and comments. The State of Alaska's Division of Government Coordination issued its Final Consistency Determination for the action in February

2000. The new NPDES permit for the John M. Asplund Water Pollution Control Facility was signed by EPA on 30 June 2000, went into effect 2 August 2000, and expires on 2 August 2005.

The NPDES permit specified the required monitoring program. The *Monitoring Program Plan* (Kinetic Laboratories, Inc., 2000a), submitted to the EPA in October 2000, identified how the MOA plans to fulfill the requirements of this program. This report documents the progress and results of the monitoring program during the first partial year (August - December) under the 2000 NPDES permit. In addition, data have been presented for the period of 1 January through 1 August 2000 that were collected as required by the original 1985 permit. All data presented in this report have been compared with the 2000 permit limitations.

1.1.2 Environmental Background

The John M. Asplund Water Pollution Control Facility discharges to the receiving waters of Cook Inlet, Alaska. The discharge is located off Point Woronzof in Knik Arm of Upper Cook Inlet.

Cook Inlet is a major tidal estuary that is approximately 333 kilometers (km; 180 nautical miles) long and 93-148 km (50-80 nautical miles) wide at its lower end. Bathymetry indicates the Inlet is deep, generally 36.6 m (20 fathoms) north of the Forelands and about 164.6 m (90 fathoms) at the mouth. Numerous rivers, including the major Susitna River drainage, discharge into the Inlet. A detailed map of the Point Woronzof region indicates deep water (9.1-51.8 m) extending well past Anchorage up the Knik Arm (Figure 2).

Cook Inlet is a unique estuary, with perhaps the closest parallel being the Bay of Fundy between New Brunswick and Nova Scotia, Canada. The occurrence of tidal bores at the head, currents of 4-5 knots, suspended loads of up to 2500 mg/L, large temperature extremes, and moving pancake ice of up to one meter thick make Cook Inlet unique. The high tidal ranges result from the geometry of the Inlet which has a natural resonance period close to the semi-diurnal tidal period. The resulting large tidal currents cause complete vertical mixing of the Inlet waters.

In addition to these features, two other factors are important to this study. They are the very large volume of saline water present in the Inlet and the degree of mixing achieved by the tidal turbulence which allow these volumes to be effective in wastewater dilution and assimilation.

The particle size distribution of the natural suspended sediments off Point Woronzof show that very large particles are suspended by the current-generated turbulence, with 50 percent of the load being in the size range of 65-250 microns. The settling of large particles is seen in the Inlet at slack tide. Settling rate tests of the suspended material show that 93 percent of the solids in the ambient water sample settle in twenty minutes.

Previous work has indicated that due to the extremely swift currents, no seabed accumulation of suspended sediments, either natural or from the discharge, occur in the vicinity of the outfall. In this location, the bottom is strictly coarse gravel and cobble because of these currents. However, areas of deposition do exist, such as to the east of Point Woronzof, where mudflats and beaches are found, and to the southwest of the Point. The area between Fire Island and the mainland is hard-packed sand with no deposition of silt or finer materials as a result of the high current energy. Silt sedimentation is a difficult problem at the Port of Anchorage where the Corps of Engineers conduct

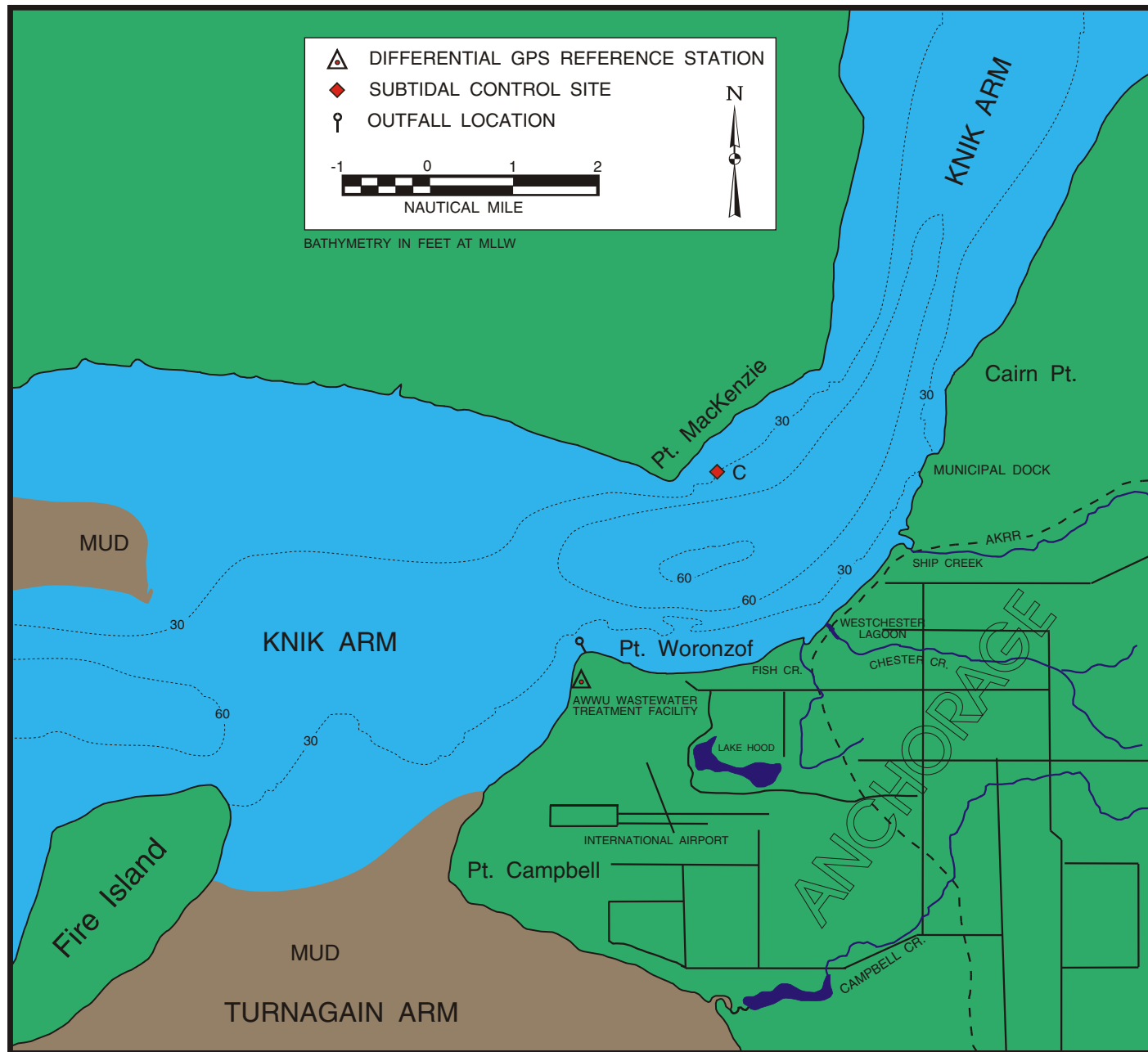


Figure 2. Point Woronzof Outfall, Differential GPS Station, and Control Station Locations.

annual dredging operations. Of course, any suspended solids in these materials of effluent origin would be diluted by the much larger natural load in the receiving water (400-2,500 mg/L versus approximately 50 mg/L effluent).

Studies have also shown that essentially no benthic biota are found on the scoured cobble/gravel bottom or on the rock beaches at Point Woronzof and the control area. Similar sampling of soft bottom beaches and tidal flats showed very sparse abundances and very low diversities. The harsh physical environment of silt, turbulence, currents, tides, and ice limit benthic and intertidal marine fauna populations.

Current trajectories in the immediate vicinity of the outfall are of concern because of flow separation zones on either side of Point Woronzof. Previous work has indicated that, on a flood tide, a clockwise system of eddies exist east of Point Woronzof. These eddies may result in the shoreward transport of wastes at certain stages of tide. A flow separation also exists to the west of Point Woronzof during ebb flow, however the effluent is not entrained shoreward in this area.

1.2 STUDY DESIGN

1.2.1 Monitoring Objectives

The monitoring program as described by NPDES Permit No. AK-002255-1 includes plant influent/effluent sampling; sewage sludge management procedures; water quality monitoring; biological and toxicological monitoring; and a toxics control program. The objectives of the overall monitoring program are to:

- determine compliance with the NPDES permit
- determine compliance with State of Alaska water quality criteria
- determine effectiveness of the industrial pretreatment program
- aid in assessing the water quality at the discharge point
- characterize toxic substances
- monitor plant performance
- determine compliance with the regulatory criteria of Section 301(h) of the Clean Water Act (CWA)
- determine the level of bacterial concentrations in nearshore waters
- monitor for changes in sediment quality (organic enrichment, alteration of grain size distribution, and pollutant contamination)
- determine if pollutants from the discharge are accumulating in exposed biological organisms
- provide data for evaluating re-issuance of this permit

1.2.2 Program Description

The elements of the monitoring program for the Point Woronzof Wastewater Treatment Facility (WWTF) are:

- Influent, Effluent, and Sludge Monitoring, including
 - In-Plant Sampling
 - Toxic Pollutants and Pesticides (including Metals and Cyanide)

- Pretreatment Program
- Whole Effluent Toxicity Testing (WET)
- Receiving Water Quality Monitoring, including
 - Plume Dispersion
 - Intertidal Bacteria
- Biological and Sediment Monitoring, including
 - Sediment Quality
 - Bioaccumulation

Table 1 provides an overview of the general monitoring requirements as described by the permit. Detailed information regarding each of these program components is provided in Section 2.0, Methods.

1.2.3 Hypotheses

The null (no effect) hypotheses tested in Year 1 of the new NPDES permit were the following:

- H₀1: Applicable State and Federal effluent and receiving water standards were met by the Point Woronzof discharge.
- H₀2: Water quality at the boundary of the ZID was not significantly changed with respect to nearfield or control stations.

1.3 CONTRACTOR

The MOA's designated contractor for the 2000 Point Woronzof Monitoring Program was Kinnetic Laboratories, Inc. (KLI) of Anchorage, Alaska. Contract administrative and technical review were provided by CH2M Hill.

For influent, effluent, and sludge monitoring, volatile and semivolatile priority pollutant analyses (gas chromatography/mass spectrometry scans) were performed by Severn Trent Services, Inc. (Anchorage, Alaska). Trace metals (total and dissolved antimony, selenium, and thallium), aromatic hydrocarbon, pesticide, and WET testing were conducted by ToxScan, Inc. in Watsonville, California. Asbestos analyses were performed by Solar Environmental Services, Inc. of Anchorage, Alaska.

In addition, the Municipality's Point Woronzof Laboratory performed monthly in-plant monitoring and analyses as part of its self-monitoring program and conducted trace metals and cyanide analyses for the toxic pollutant and pesticide, pretreatment, and Part 503 sludge monitoring.

Northern Testing Laboratories, Inc. (NTL) of Anchorage, under subcontract to KLI, provided analytical and field support for the receiving water quality sampling for bacteriology, color, total residual chlorine, and polycyclic aromatic hydrocarbons (PAHs). Analytical support for the receiving water sampling was also provided by Battelle Northwest for trace metals (Sequim, Washington), and by ToxScan, Inc. for aromatic hydrocarbons, total suspended solids, and cyanide.

Table 1. Overall Monitoring Requirements.

Parameter	Frequency	Sample Type	Remarks
In-Plant Sampling	See Table 2	See Table 2	See Table 2 - includes flow, TRC, DO, BOD ₅ , TSS, temperature, pH, fecal coliform, total ammonia as nitrogen, enterococci bacteria, and oil and grease
Toxic Pollutants and Pesticides (including Metals and Cyanide)	2/year ^a	influent, 24-hr composite effluent, 24-hr composite sludge, 24-hr composite	See Table 2
Pretreatment Program	2/year ^{a,b}	influent, three 24-hr composite effluent, three 24-hr composite sludge, 24-hr composite (8 grabs/day)	Includes metals and cyanide plus percent solids for sludge
Whole Effluent Toxicity (WET) Testing	4/year ^c	effluent, 24-hr composite	See Table 2
Receiving Water Quality	1/year ^d	receiving water	See Table 5
Intertidal Bacteria	1/year ^e	intertidal receiving water	Fecal coliform sampling at 8 intertidal stations
Sediment	Once during the fourth year of the permit ^e	grab samples of surficial (0-2 cm) sediment collected at intertidal and subtidal stations ^f	Includes total volatile solids (TVS), toxic pollutants and pesticides (including metals and cyanide), and sediment grain size distribution
Bioaccumulation	Once during the fourth year of the permit ^{e,g}	grab samples of intertidal macroalgae (<i>Vaucheria</i> spp.) ^h	Includes toxic pollutants and pesticides (including metals and cyanide)

^a Twice per year sampling will be conducted twice, once in dry conditions in summer and once in wet conditions.

^b The first day of three consecutive days of sampling will be part of the Toxic Pollutant and Pesticides (metals and cyanide) sampling performed twice each year.

^c WET testing will be performed on a quarterly basis.

^d Sampling will be conducted once per year in summer dry conditions.

^e Sampling will be conducted in conjunction with the receiving water sampling.

^f Sampling will be performed at Intertidal Stations 1, 2, and Control (IT-1, IT-2, and IT-C); a subtidal station located at the ZID boundary, and a subtidal control station near Point MacKenzie (in a similar water depth as the ZID boundary).

^g Sampling will be performed in conjunction with the sediment analyses.

^h Samples will be collected at Intertidal Stations 1 (IT-1) and Control (IT-C). Ten replicate samples will be collected within a 10-m radius of the station.

1.4 PERIOD OF REPORT

This report covers the period of 1 January through 31 December 2000. The report documents the progress and results of the monitoring program from 2 August through 31 December 2000 under the 2000 NPDES permit. In addition, data have been presented where appropriate for the period of 1 January through 1 August 2000 that were collected as required by the original 1985 permit. All program data are compared where appropriate to permit limitations as provided in the 2000 permit.

2.0 METHODS

2.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

Influent, effluent, and sludge monitoring is outlined in Table 2. Routine daily, weekly, and monthly sampling of conventional pollutant parameters and flow rate were performed by AWWU. The less-frequently monitored parameters of enterococci bacteria, oil and grease, toxic pollutants and pesticides (including metals and cyanide), and Whole Effluent Toxicity (WET) testing were handled by KLI.

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ determine effectiveness of the industrial pretreatment program
- ✓ aid in assessing the water quality at the discharge point
- ✓ characterize toxic substances
- ✓ help monitor plant performance
- ✓ determine compliance with the regulatory criteria of Section 301(h) of the CWA
- ✓ provide data for evaluating re-issuance of this permit

2.1.1 In-Plant Monitoring

In-plant influent, effluent, and sludge sampling was performed by AWWU personnel as described in Table 2 and in a separate study plan provided by AWWU (AWWU, 2000). Samples were obtained following the schedule of frequency required by the permit. Influent was sampled at a representative location in the influent headworks, upstream from the recycle streams. Effluent was sampled at a well-mixed point downstream from the chlorination input (the final effluent line). Composite sludge samples were obtained from the belt filter press. Under the current permit, grab samples were obtained for total residual chlorine (TRC), dissolved oxygen (DO), temperature, pH, and fecal coliform. Composite samples were obtained for analysis of biochemical oxygen demand (BOD₅), total suspended solids (TSS), and total ammonia as nitrogen.

2.1.2 Toxic Pollutant and Pesticide Monitoring

As outlined in the permit, toxic pollutant and pesticide sampling was conducted twice this year, once during June 2000 (summer dry under the old permit) and once during August 2000 (under the 2000 permit). Samples were collected as required by the permits and either analyzed by AWWU personnel or provided to KLI for shipment to the appropriate analytical laboratory. Plant influent was sampled as discrete grabs or by flow-proportional composite samplers (depending on the analysis method) at a representative location in the influent headworks upstream from the recycle streams. Effluent was sampled as discrete grabs or flow-proportional samplers at a well-mixed point downstream from the chlorination input point in the final effluent line. Influent and effluent samples were chilled as required during composite sampling. Composite sludge samples were obtained from the belt filter press.

Samples were composited for the analysis of pesticides, semi-volatile organics, metals, asbestos, and cyanide. With the exception of cyanide for the June 2000 sampling, influent and effluent samples for both June and August 2000 consisted of composites of flow-proportioned samples collected over a 24-hr period. Influent and effluent cyanide samples collected in June 2000 consisted of three grabs taken eight hours apart, preserved immediately, and composited after flow weighting. For the June 2000 sampling, sludge composite samples consisted of 100-mL samples collected every hour over

Table 2. Influent, Effluent, and Sludge Monitoring Requirements.

Parameter	Sample Point ^a	Sample Frequency	Sample Type
Flow ^b	effluent	continuous	continuous
Total Residual Chlorine (TRC) ^b	effluent	continuous <u>or</u> every 2-4 hrs	grab
Dissolved Oxygen (DO) ^b	effluent	4/week	grab
Biochemical Oxygen Demand (BOD ₅) ^b	influent and effluent	4/week	24-hr composite
Total Suspended Solids (TSS) ^b	influent and effluent	4/week	24-hr composite
Temperature ^b	influent and effluent	4/week	grab
pH ^b	influent and effluent	4/week	grab
Fecal Coliform Bacteria ^b	effluent	3/week	grab
Total Ammonia as N ^b	effluent	1/month	24-hr composite
Enterococci Bacteria ^c	effluent	2/year ^d	grab
Oil and Grease ^b	effluent	2/year ^d	grab
Toxic Pollutants and Pesticides (including Metals and Cyanide) ^e	influent, effluent, and sludge	2/year ^d	24-hr composite
WET ^f	effluent	4/year ^f	24-hr composite

^a When both influent and effluent samples are required, samples will be collected during the same 24-hr period.

^b AWWU will perform this monitoring component.

^c KLI will perform this monitoring component.

^d Twice per year sampling: once during summer in dry conditions and once in wet conditions.

^e As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge will be sampled, along with percent solids (in sludge only). These metals will be analyzed and reported by AWWU as total recoverable metals and dissolved metals for influent and effluent and as total metals in mg/kg dry weight for sludge. Sampling will be as follows: Influent and effluent as three separate 24-hr composite samples taken on 3 consecutive days (Mon - Fri), the first day of which coincides with the twice yearly sampling (summer-dry and wet conditions); sludge as one composite of eight grabs/day when influent and effluent samples are being taken. In addition, the other four metals from the toxic pollutant list will be analyzed in the summer wet/summer dry samples: beryllium (by AWWU) and antimony, thallium, and selenium (by KLI).

^f WET requirements are summarized in the text. Initial testing will be a screening period performed during three quarters, during which three species will be tested to determine the most sensitive species. Re-screening will be performed each year during one quarter (different than the previous year) to determine the species to use for continued testing. Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TU_c (chronic toxicity units, TU_c=100/NOEC).

the 24-hr period. In August 2000, sludge samples were collected every three hours over a 24-hr period and the eight samples composited. During both sampling periods, grab samples for volatile organics analysis were collected every three hours during the 24-hr sampling period and designated for compositing during analysis at the laboratory. Grab samples were collected for analysis of total hydrocarbons as oil and grease, petroleum hydrocarbons, and purgeable aromatic compounds.

At time of collection, all samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.4.

Toxic pollutants as defined by the permit are those substances listed in 40 CFR 401.15 (Table 3). This list involves 65 categories of pollutants, including asbestos, aromatic hydrocarbons, pesticides, metals, and polychlorinated biphenyls (PCBs). Pesticides as defined in the permit are demeton, guthion, malathion, mirex, methoxychlor, and parathion as listed in 40 CFR 125.58. Other pesticides which were tested are included on the toxic pollutants list (40 CFR 401.15). The methods that were used to analyze these constituents for this program and for which KLI will be responsible are also provided in Table 3. Preservation and maximum holding time information for each of these methods is provided in Table 4. All samples were collected in the appropriate precleaned sample containers and preserved, if necessary, as described by the EPA method. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

2.1.3 Pretreatment Monitoring

The pretreatment program as outlined in Tables 1 and 2 was performed by the AWWU. This monitoring was performed for the first time in August 2000 and will be performed twice per year in the future in conjunction with the summer-dry and wet sampling. As part of the pretreatment program sampling requirements, arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel, silver, and zinc in influent, effluent, and sludge will be sampled, along with percent solids (in sludge only). These metals will be analyzed and reported by AWWU as total recoverable metals and dissolved metals for influent and effluent and as total metals in dry weight for sludge. Sampling will be as follows: Influent and effluent as three separate 24-hr composite samples taken on 3 consecutive days (Monday - Friday), the first day of which coincides with the twice yearly sampling (dry summer and wet conditions); sludge as one composite of eight grabs/day when influent and effluent samples are being taken. A study plan has been provided elsewhere (AWWU, 2000).

2.1.4 Whole Effluent Toxicity Testing

As outlined in the permit, the WET testing must be performed on a quarterly basis on 24-hour composite effluent samples. Effluent was sampled by discrete flow-proportional samplers at a well-mixed point downstream from the chlorination input point in the final effluent line. Effluent samples were collected in the appropriate precleaned sample containers as described by the method, chilled, and shipped immediately to the toxicity laboratory for testing. Samples were appropriately labeled at the time of collection using pre-prepared, project-specific sample labels as described in Section 2.4. Sample collection and shipment were documented using project-specific chain of custody forms as described in Section 2.4. Sample containers were immediately placed on gel ice after sampling and remained chilled during shipment to the analytical laboratory.

Table 3. Methods^a for the Analysis of Toxic Pollutants and Pesticides for Influent, Effluent, and Sludge Monitoring.

Volatile Organic Compounds	Semi-Volatile Organic Compounds	Pesticides and PCBs	Inorganic Compounds
EPA 602 (Inf/Eff) SW 8260B (Sludge) Benzene Chlorinated benzenes Dichlorobenzenes Ethylbenzene Toluene Xylenes ^b	EPA 625 (Inf/Eff) SW 8270C (Sludge) Acenaphthene Benzidine ^c Chloralkyl ethers Chlorinated ethanes Chlorinated naphthalenes Chlorinated phenols 2-chlorophenol DDT & metabolites Dichlorobenzenes Dichlorobenzidine 2,4-dichlorophenol 2,4-dimethylphenol Dinitrotoluene Diphenylhydrazine Fluoranthene Haloethers Heptachlor & metabolites Hexachlorobutadiene Hexachlorocyclopentadiene ^c Hexachloroethane Isophorone Naphthalene Nitrobenzene Nitrophenols Nitrosamines Polycyclic aromatic hydrocarbons (PAHs) Pentachlorophenol Phenol Phthalate esters 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) ^d	EPA 614 (Inf/Eff) SW 8141A (Sludge) Demeton Malathion Parathion Guthion ^b EPA 608 (Inf/Eff) SW 8081A Pesticides and SW 8082 PCBs (Sludge) Aldrin/Dieldrin Chlordane (technical mixture & metabolites) DDT & metabolites Endosulfan & metabolites Endrin & metabolites Heptachlor & metabolites Hexachlorocyclohexane Polychlorinated biphenyls (PCBs) Toxaphene Mirex ^b Methoxychlor ^b	EPA 100.1/EPA 100.2 (Inf/Eff) Polarized Light Microscopy (PLM; Sludge) Asbestos EPA 200.8 (Inf/Eff) SW 6020/SW 3050B (Sludge) Antimony Thallium EPA 270.3 (Inf/Eff) SW 7741A/SW 3050B (Sludge) Selenium Note: other inorganic compounds will be analyzed by AWWU (Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, Zinc, and Cyanide)
EPA 624 (Inf/Eff) SW 8260B (Sludge) Acrolein ^b Acrylonitrile ^b Benzene Carbon tetrachloride Chloralkyl ethers Chloroform Chlorinated benzenes Chlorinated ethanes 1,2-dichloroethane Dichloroethylenes Dichloropropane Dichloropropene 1,1,1-trichloroethane Ethylbenzene Halomethanes Methylene chloride Bromoform Dichlorobromomethane Toluene Tetrachloroethylene Trichloroethylene Vinyl chloride			

Inf - Influent

Eff - Effluent

^a "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020 or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992. "SW" refers to the EPA Manual SW 846, *Test Methods for Evaluating Solid Waste*. 3rd Ed., 1986.

^b Included with expanded method analyte list.

^c Not the preferred method for this analyte.

^d TCDD: Methods 625/8270C will be used to screen for TCDD; Methods 613/8280A will be used to quantify TCDD if present.

Table 4. Preservation and Maximum Holding Times for Influent, Effluent, and Sludge Analyses.

Method ^a	Parameter	Preservation	Maximum Holding Time
Influent and Effluent			
EPA 602 and xylenes EPA 624	Volatile Organics	Cool, 4°C HCl to pH<2 Na ₂ S ₂ O ₃ in effluent	14 days
EPA 625	Semi-Volatile Organics	Cool, 4°C, dark Na ₂ S ₂ O ₃ in effluent	7 days until extraction 40 days after extraction
EPA 614 and EPA 608	Pesticides and PCBs	Cool, 4°C Na ₂ S ₂ O ₃ in effluent NaOH or H ₂ SO ₄ if not extracted within 72 hrs	7 days until extraction 40 days after extraction
EPA 613 (if needed)	TCDD	Cool, 4°C, dark Na ₂ S ₂ O ₃ in effluent	7 days until extraction 40 days after extraction
EPA 200.8	Antimony and Thallium (Total recoverable and dissolved)	Cool, 4°C HNO ₃ to pH <2 (after filtration for dissolved)	6 months
EPA 270.3	Selenium (Total recoverable and dissolved)	Cool, 4°C HNO ₃ to pH <2 (after filtration for dissolved)	6 months
EPA 100.1/100.2	Asbestos	Cool, 5°C, dark	Filter within 48 hrs of receipt at lab
SM 9230B	Enterococci	Cool, 4°C, Na ₂ S ₂ O ₃ in effluent	24 hrs
Sludge			
SW 8260B	Volatile Organics	Cool, 4°C	14 days
SW 8270C	Semi-Volatile Organics	Cool, 4°C	14 days until extraction 40 days after extraction
SW 8141A and SW 8081A	Pesticides	Cool, 4°C	14 days until extraction 40 days after extraction
SW 8082	PCBs	Cool, 4°C	14 days until extraction 40 days after extraction
SW 8280A (if needed)	TCDD	Cool, 4°C	14 days until extraction 40 days after extraction
SW 3050B/SW 6020	Antimony and Thallium	Cool, 4°C	28 days
SW 3050B/SW 7741A	Selenium	Cool, 4°C	28 days
Polarized Light Microscopy (PLM)	Asbestos	Cool, 5°C	28 days

^a "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020, or 40 CFR 136; "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992. "SW" refers to the EPA Manual SW 846, *Test Methods for Evaluating Solid Waste*. 3rd Ed., 1986.

Initial testing is to be performed as a screening period over the course of the three quarters, during which three toxicity tests will be performed, each with one vertebrate and two invertebrate species. Testing was initiated with the first screening test during the third quarter of the year 2000. A subsequent screening test was performed in the fourth quarter. Testing has included the vertebrate *Atherinops affinis* (topsmelt) for survival and growth; an invertebrate bivalve species (either *Mytilus* spp. [mussel; survival and growth] or *Crassostrea gigas* [oyster; larval development]); and an invertebrate echinoderm species fertilization test (*Strongylocentrotus purpuratus* [purple urchin] or *Dendraster excentricus* [sand dollar]). Once the screening period is completed, the single most sensitive species will be used for subsequent toxicity testing. As required by the permit, re-screening will be performed each year during one quarter (different than the previous year) to determine the most sensitive species to use for continued testing.

Accelerated testing requirements will be triggered if chronic toxicity is greater than 143 TUC (chronic toxicity units, $TUC = 100 / \text{No Observed Effect Concentration [NOEC]}$). Accelerated testing will include the implementation of the initial investigation Toxicity Reduction Evaluation (TRE) workplan along with at least one additional toxicity test. If the investigation indicates the source of toxicity (e.g., a plant upset), and no toxicity greater than 143 TUC is observed in this test, the normal schedule of testing will be re-instated. If toxicity greater than 143 TUC is observed, then accelerated testing will continue with six more tests performed on a biweekly basis over a 12-week period. Testing will commence within two weeks of receipt of the sample results of the exceedance. If no toxicity greater than 143 TUC is observed in these tests, then the normal schedule of testing will be re-instated. If toxicity greater than 143 TUC is observed in any of the six tests, then a TRE will be initiated within 15 days of receipt of the sample results of the exceedance. A Toxicity Identification Evaluation (TIE) may also be initiated as part of the overall TRE process, and if this is initiated during the accelerated testing period, the accelerated testing schedule may be terminated or used as necessary in performing the TIE.

Toxicity testing was performed as described in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (EPA, 1988) and the *West Coast Marine Methods Manual, First Edition* (EPA, 1995) as required by the permit. The presence of chronic toxicity was estimated as described by these references. Quality assurance for the toxicity testing included the testing of a series of five dilutions and a control, including the concentration of the effluent at the edge of the ZID (0.70 %) as well as two dilutions above and two dilutions below 0.70 %. Reference toxicants were tested concurrently with the effluent testing, using the same procedures. If the effluent tests did not meet all the acceptability criteria as specified in the referenced methods, then the effluent was re-sampled and re-tested as soon as possible. Control and dilution water was natural or synthetic seawater as called for by the referenced methods. If the dilution water was different from the culture water, a second control using culture water will be run. Dilution water met test acceptability criteria.

As part of the WET testing, an initial investigation TRE plan was prepared and submitted to EPA under separate cover (Kinnetic Laboratories, Inc., 2000b). This plan describes the events that will occur should chronic toxicity be detected. As required by the permit and the manual *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants* (EPA, 1999), a preliminary TRE will be initiated within 15 days of the receipt of sample results of the permit exceedance. A more detailed TRE workplan will subsequently be developed to more fully investigate and identify the cause of the toxicity, identify and provide a schedule of the actions that

AWWU will use to mitigate the impact of the discharge, and to prevent the recurrence of the toxicity. As noted above, the TIE may be initiated as part of the overall TRE process during the accelerated testing schedule.

2.1.5 Part 503 Sludge Monitoring

Operations at the Point Woronzof WWTF include a sludge incinerator that is subject to regulation under 40 CFR Part 503—*Standards for the Use or Disposal of Sewage Sludge* (Part 503). Sludge was monitored monthly prior to August 2000 as a requirement of the facility's NPDES permit, and these data have been submitted directly to EPA. The reissued permit, effective 2 August 2000, requires sludge monitoring twice per year, once during the dry conditions in summer and once during wet conditions as noted above. There are no Part 503 monitoring requirements included in the reissued permit because EPA Region 10's current policy is to remove these requirements from NPDES permits with the intention of writing "sludge only" permits in the future. However, the Part 503 regulations are "self-implementing" in that the facility is required to meet the monitoring requirements in the regulation whether they are specifically included in a permit or not. Therefore, monitoring at the Point Woronzof plant includes Part 503 monitoring of sludge. While methods for this monitoring component have been described elsewhere (AWWU, 2000) and results of the monitoring have been provided under separate reporting requirements to EPA, the annual sludge monitoring data are included in the results section of this report for completeness.

2.2 RECEIVING WATER QUALITY MONITORING

2.2.1 Water Quality Sampling

As called for by the permit, water quality will be monitored annually during the summer in dry weather conditions as called for by the permit (Table 1). Sampling was performed at non-fixed stations made during a consecutive flood and ebb tide at the outfall station and a single flood tide at the control station. Station locations were determined by following the track of drogues released above the diffuser at

- ✓ determine compliance with the NPDES permit and State of Alaska water quality criteria
- ✓ aid in assessing the water quality at the discharge point
- ✓ determine compliance with the regulatory criteria of Section 301(h) for the CWA
- ✓ determine the level of bacterial contamination in nearshore waters
- ✓ provide data for evaluation re-issuance of this permit

the outfall station and at the control station which was located north across Knik Arm from Point Woronzof, directly off Point MacKenzie in a similar water depth as the outfall. Three drogue tracks on the each tide (flood and ebb tides at the outfall and flood tide at the control) were performed at each location. Four stations were sampled on each drogue track:

- above the diffuser
- as close to the ZID boundary as practicable
- at least one station in the channel of Knik Arm
- in the shallow subtidal area before the drogue grounds.

As noted in the permit, the ZID is defined as the water column above the area delineated by the sector of a circle with the center located over the outfall, 30 meters (m) shoreward of the diffuser, 650 m in radius, and with a 220° angle (Figure 3).

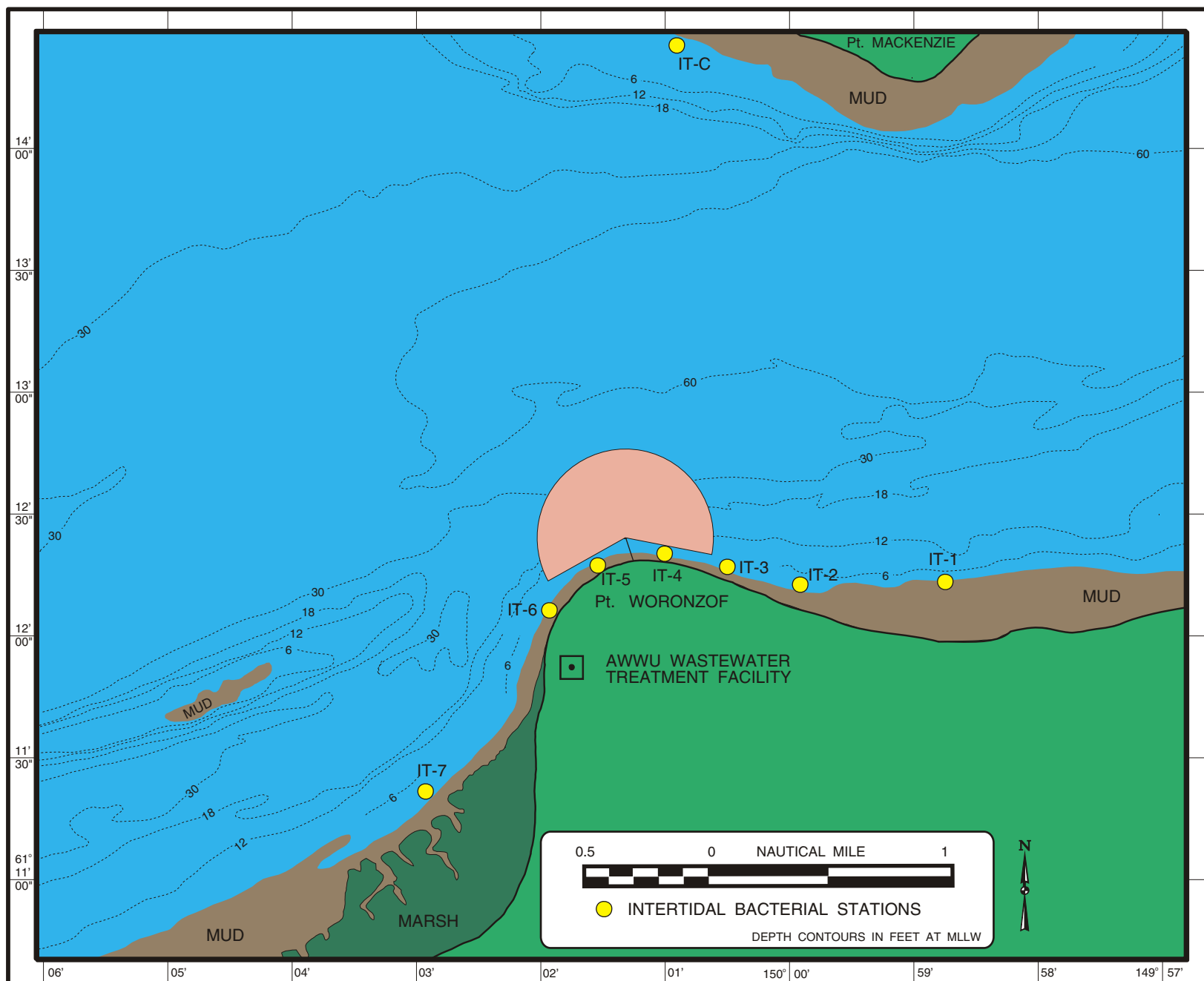


Figure 3. Point Woronzof Outfall Showing the ZID and Locations for Intertidal Bacterial Sampling.

The plume location was followed by using a holey-sock drogue (Figure 4). The drogue consisted of a six-foot cylindrical nylon tube ballasted at the bottom with a five-pound weight and attached at the top with a bridle to a spherical float. This float attached to the tracking spar via a connecting line. These cylindrical or spherical designs that enclose a parcel of water have been found to more accurately follow the ambient current patterns than other drogue designs such as the window shade design (Sombardier and Niiler, 1994).

Sampling was performed by positioning the vessel over the diffuser (or control station) for the first sampling station of the drogue track. The drogue was released at approximately the same time and followed until navigation information indicated that the ZID has been reached, at approximately 650 m from the start of the drogue track, at which time the ZID boundary station was sampled. The third and fourth stations along each drogue track were sampled as the drogue traveled through the channel in Knik Arm and as it slowed in shallow water prior to grounding. Navigation was accomplished using a differential global positioning system (DGPS) using the U.S. Coast Guard's DGPS station in Kenai, Alaska. Alternatively, a differential beacon was installed at Point Woronzof prior to the field effort to ensure differential positioning. If DGPS coordinates were unavailable or inaccurate, a standard GPS receiver was used to obtain navigational information. Range and bearing to fixed landmarks on shore using the vessel's radar may also have been recorded to aid in station positioning.

Samples were collected for the parameters outlined in Table 5. The surface waters of all stations were sampled for fecal coliform, color, and TRC. Surface samples were collected by grabbing directly into the appropriate sample bottles at sample depth (15 - 30 centimeters [cm]). Turbidity samples were collected at all stations from surface (0.5 m), mid-, and bottom depths using Niskin[®] bottles. Mid- and bottom depths were determined at each station using the survey vessel's fathometer. Samples were collected as simultaneously as possible at all three target depths. Hydrographic profiles of temperature, salinity, and pH were collected at all stations using a Seabird SEACAT[®] CTD (conductivity, temperature, and depth) sensor. This instrument was also equipped with a DO sensor to allow DO profiles to be recorded. Samples for the analysis of total and dissolved metals, TSS, total aqueous hydrocarbons (TAqH), and total aromatic hydrocarbons (TAH) were collected from surface waters at the first three stations (diffuser, ZID boundary, and channel) along the first flood drogue track at both the outfall and control stations. These samples were collected directly into the appropriate sample containers. A single replicate sample for each parameter or a single profile was collected at each station except for quality control samples, which are described in Section 4.2.

Samples were analyzed following the methods provided in Table 6. Total residual chlorine samples were analyzed onboard the sampling vessel. Other samples were appropriately labeled at time of collection using pre-prepared, project-specific sample labels as described in Section 2.4 and prepared for shipment to the laboratory. Preservation and maximum holding time information for each of these methods is also provided in Table 6. All sample containers were immediately placed on gel ice after sampling. Samples remained chilled as required during shipment to the analytical laboratory.

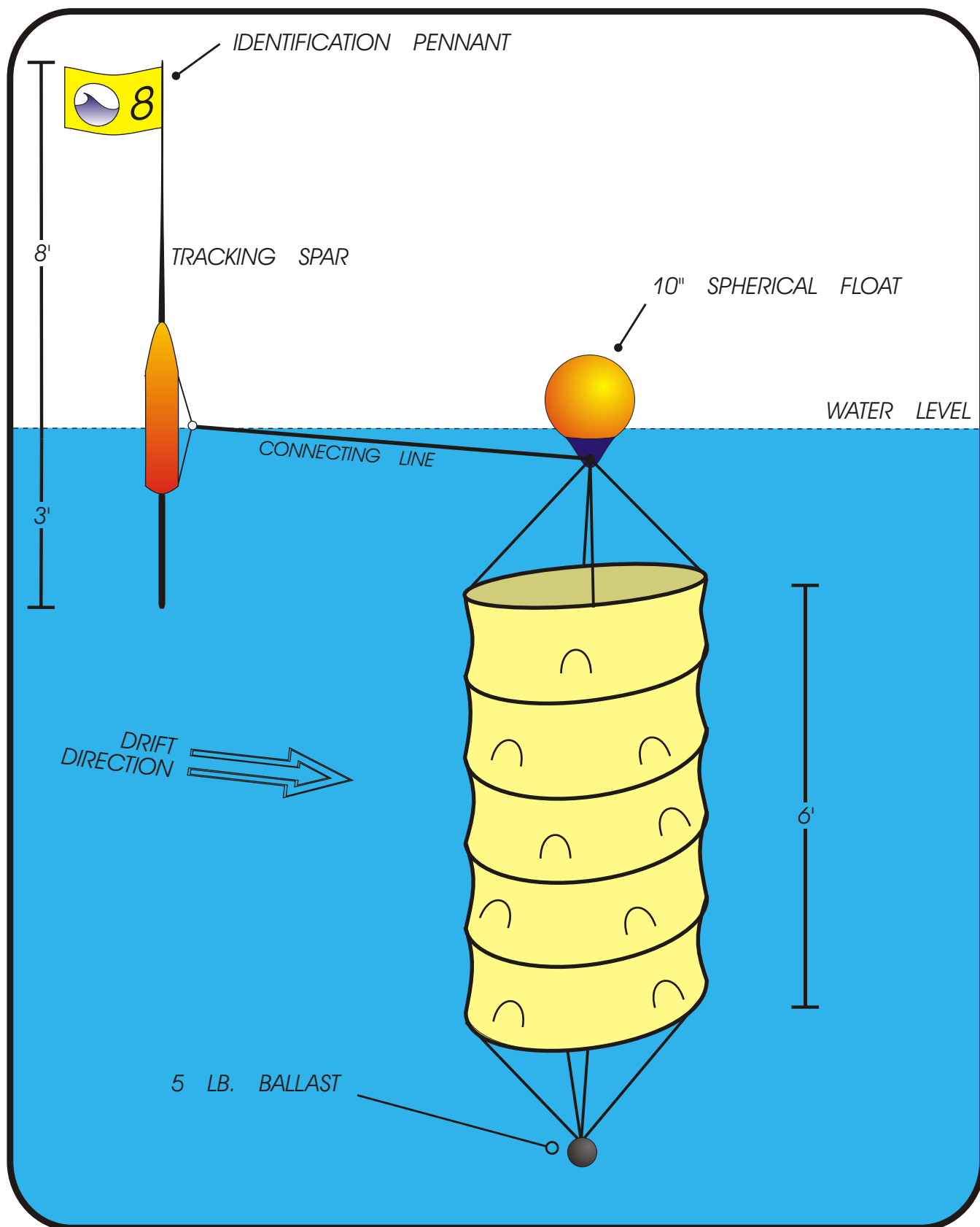


Figure 4. Holey-Sock Drogue, Flotation, and Marker Buoy.

Table 5. Receiving Water Quality Monitoring Requirements.

Parameter	Sampling Depth		
	Surface (above 0.5 m)	Surface, Mid-, and Bottom	Profile (1- to 3-m intervals)
Fecal Coliform	all stations ^a , within the 15-30 cm layer		
Color	all stations		
Total Residual Chlorine (TRC)			
Field Observations: presence or absence of floating solids, visible foam (other than trace), oil wastes, and/or sheen	all stations where surface samples are collected		
Total Aqueous Hydrocarbons (TAqH)	first three stations along the first flood drogue track at both the outfall and control locations		
Total Aromatic Hydrocarbons (TAH)			
Metals and Cyanide ^b			
Total Suspended Solids (TSS)			
Turbidity		all stations	
Dissolved Oxygen (DO)			
pH			all stations
Temperature			
Salinity			

^a Non-fixed stations will be sampled following the track of drogues released at the diffuser (outfall station) or at a fixed station having the same depth due north across Knik Arm from Point Woronzof near Point MacKenzie (control station). Three drogue tracks will be made during each of a consecutive flood and ebb tide at the outfall station. Three drogue tracks will be made during a flood tide at the control station in conjunction with or as soon as practicable as the sampling at the outfall station. Stations will include the following along each drogue track: above the diffuser; as close to the ZID boundary as possible; at least one station in the channel in Knik Arm; and the shallow subtidal area (before the drogue grounds).

^b Metals include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc will be analyzed and reported as total recoverable metals and dissolved metals.

Table 6. Methods, Preservation, and Maximum Holding Times for the Analysis of Receiving Water Quality Samples.

Parameter	Method ^a	Preservation	Maximum Holding Time
Fecal Coliform	SM 9221E	Cool, 4°C, dark	24 hours
Color	SM 2120B	Cool, 4°C, dark	48 hours
Total Residual Chlorine (TRC)	SM 4500-Cl D	None	Analyze immediately
Turbidity	SM 2130B	Cool, 4°C, dark	24 hours
Total Aqueous Hydrocarbons (TAqH)	EPA 602 plus xylenes	Cool, 4°C, HCl to pH<2, Na ₂ S ₂ O ₃ in presence of chlorine	14 days
	EPA 610	Cool, 4°C, dark, Na ₂ S ₂ O ₃ in presence of chlorine	7 days until extraction 40 days after extraction
Total Aromatic Hydrocarbons (TAH)	EPA 602	Cool, 4°C, HCl to pH<2, Na ₂ S ₂ O ₃ in presence of chlorine	14 days
Metals (Total Recoverable and Dissolved)	See note ^b	Cool, 4°C, HNO ₃ to pH <2 (after filtration for dissolved)	28 days
Cyanide	EPA 335.3	NaOH, 4°C	14 days
Total Suspended Solids (TSS)	EPA 160.2	Cool, 4°C	7 days
Dissolved Oxygen (DO)	SM 4500-O G (electrode)	None	<i>in situ</i>
pH	SM 4500-H ⁺ B	None	<i>in situ</i>
Temperature	SM 2550B ^c	None	<i>in situ</i>
Salinity	SM 2520B ^c	None	<i>in situ</i>

^a "EPA" refers to the EPA document *Methods for Chemical Analysis of Water and Wastes*, revised March 1983, Document No. EPA-600/4-79-020, or 40 CFR 136. "SM" refers to *Standard Methods for the Examination of Water and Wastewater*, 18th ed., 1992.

^b Dissolved metals will be filtered before acidification; total recoverable metals will be digested by ASTM Method D4309-91. Cadmium, chromium, copper, nickel, lead, and zinc will be subject to pre-concentration by chelation following EPA Method 1640 prior to analysis by inductively coupled plasma mass spectroscopy. These metals, along with antimony, beryllium, selenium, and thallium, will be analyzed as total recoverable and dissolved metals as appropriate for ICP/MS (EPA Method 1638). Mercury will be analyzed using cold vapor atomic fluorescence following EPA Method 1631. Arsenic will be determined in all samples by flame ionization atomic spectroscopy (SW846 Method 7062). Silver will be determined by graphite furnace atomic absorption (EPA Method 200.9).

^c Modified for *in situ* measurements collected with the CTD.

2.2.2 Intertidal Bacterial Sampling

As part of the water quality monitoring effort, intertidal sampling for fecal coliform bacteria was also performed at eight intertidal stations provided in Table 7 and depicted in Figure 3. Two replicate water samples were collected from each station at slack high water when the water depths were between 1 to 3 feet (ft). Additional quality control samples were collected as described in Section 4.1. Samples were collected by grabbing from 15 - 30 cm directly into the appropriate container. Samples were analyzed using the same procedures described above and in Table 6.

Table 7. Approximate Locations of Intertidal Bacteria Sampling Stations.

Station	Station Location Relative to Diffuser	Latitude (N)	Longitude (W)
IT-1	2000 m east	61° 12' 10"	149° 58' 55"
IT-2	1200 m east	61° 12' 11"	149° 59' 50"
IT-3	750 m east	61° 12' 15"	150° 00' 20"
IT-4	250 m east-southeast	61° 12' 19"	150° 00' 52"
IT-5	250 m south	61° 12' 15"	150° 01' 10"
IT-6	750 m southwest	61° 12' 02"	150° 01' 28"
IT-7	2000 m southwest	61° 11' 22"	150° 02' 02"
IT-C	Across Knik Arm from the diffuser	61° 14' 26"	150° 01' 09"

In addition to the required intertidal samples, two replicated fecal coliform samples were also collected once during the water quality monitoring effort from three area streams that empty into Knik Arm: Ship, Chester, and Fish Creeks. Samples were analyzed using the same procedures described above and in Table 6.

At time of collection, all fecal coliform samples were appropriately labeled using pre-prepared, project-specific sample labels as described in Section 2.4. All samples were collected in the appropriate precleaned sample containers and preserved, if necessary, as described by the method. Samples were placed on gel ice immediately after sampling and remained chilled during transport to the laboratory. Field notes, including navigational and sampling information, were recorded on project-specific field logs. As required by the permit, field observations taken at each station included the presence or absence of floating solids, visible foam in other than trace amounts, oily wastes, or sheen. Weather observations were also recorded. All field documentation was reviewed by the field leader at the completion of the survey. Sample collection and shipment was documented using project-specific chain of custody forms as described in Section 2.4.

2.2.3 Vessel Support

The vessel used for the 2000 survey was the F/V *CUTWATER*. In addition, a 14-ft Zodiac® was used to retrieve grounded drogues and conduct intertidal bacteria sampling. The Zodiac® was also used

to transport samples with short holding times (e.g., DO and bacterial samples) ashore after each tidal cycle of drogue drops.

2.3 LABORATORY ANALYSIS

Laboratory analyses of all samples for this program followed preservation and analysis procedures described by EPA-accepted protocols as referenced in this document. These procedures are fully described by the referenced documents and/or 40 CFR 136.

2.4 DOCUMENTATION PROCEDURES

All field and sampling data was recorded on appropriate pre-printed project-specific field data forms. Field data forms included drogue tracking forms, water sampling log forms, sample identification/chain of custody forms, and sample labels. These log forms were tailored to the monitoring program to facilitate accurate and complete documentation of field activities. The field task leader was responsible for review and approval of all field documentation; this was completed as soon as possible after sampling.

Sampling logs included specific information such as station identification, sample identification numbers, navigational data, sampling or photographic observations, sampling depths, and collection date and time. Names of personnel performing the sampling were recorded on each log. Drogue tracking logs included station identification information along with navigational data to allow the track of each drogue to be determined and plotted. Pre-printed labels included such information as station designation, analysis type, date of collection, sampling personnel, and a pre-assigned sample identification number to uniquely identify each sample. Quality control samples were labeled as were regular environmental samples so as to be blind to the laboratory analysts.

Sample identification and integrity was ensured by a rigidly-enforced chain of custody program. Sample identification/chain of custody forms (COCs) provided specific information concerning the identification, handling, and shipment of samples.

Pertinent information from the sample label was transferred onto the COC, along with other information as required. COC forms were completed, signed by field personnel, and copied if needed. In some cases, where photocopying was not convenient or possible, two-part carbonless forms were used. The original of each COC form was packed with the samples in coolers for shipment to the laboratory. The field task leader retained a copy of each form for the field records and for tracking purposes should a shipment become lost or delayed. Upon receipt of the samples at the analytical laboratory, the laboratory sample custodian signed the samples in by checking all sample labels against the COC information and noting any discrepancies as well as sample condition (e.g., containers leaking or damaged during shipment). Internal sample tracking procedures at the laboratory were initiated immediately upon receipt of samples as described by each laboratory's standard operating procedure.

2.5 SEDIMENT AND BIOACCUMULATION MONITORING

As stipulated in the NPDES permit, no sediment or bioaccumulation monitoring was performed during the program year 2000.

3.0 RESULTS

3.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

3.1.1 Monthly Discharge Monitoring Data

Results of AWWU's daily, weekly, and monthly sampling of the wastewater treatment plant influent and effluent for non-metals are presented as monthly summaries in Table 8. Averages and percent removal rates are based on the 12-month period from January through December 2000.

Removal of BOD₅ averaged 44% for the year, and removal of TSS averaged 82% for the 12-month reporting period. These averages far exceed the minimums required by the amendments to the Clean Water Act (40 CFR Part 125.60; Final Rule, 8/9/94), whereby dischargers with 301(h) waivers are required to remove 30% of BOD₅ and 30% of the suspended solids. The highest monthly average effluent BOD₅ was 144 mg/L, substantially less than the 2000 permit limitation of 240 mg/L. During each of the first seven months of the year, the monthly average for BOD₅ exceeded the 1985 permit limitation of 120 mg/L. Some of the weekly and daily average values also exceeded the limitations in the old permit during this seven-month time period. However, all of the BOD₅ values (daily, weekly, and monthly averages) reported for the calendar year 2000 met the 2000 permit limitations. Total suspended solids concentrations in the effluent were low and typical of those seen historically at Point Woronzof with the highest monthly average effluent concentration of 52 mg/L compared to the permit limit of 170 mg/L.

The highest mean monthly fecal coliform bacteria count was 252 MPN/100 mL compared to the 2000 permit limitation of 850 MPN/100 mL based on a geometric mean of at least five samples. The concentration of TRC averaged 0.8 mg/L for the year compared to the maximum daily permit limitation of 1.2 mg/L. Although other parameters such as DO, pH, and temperature do not have permit limitations, ranges were typical of those seen historically.

3.1.2 Toxic Pollutants and Pesticides Analyses

Toxic pollutant and pesticide monitoring for influent, effluent, and sludge was conducted on 6 - 7 June 2000 for summer-dry weather under the 1985 permit and 14 - 15 August 2000 for the 2000 permit, also during dry weather. Sampling was performed over a 24-hour period by AWWU personnel.

Results of the toxic pollutant and pesticide analyses are provided in Tables 9 (June 2000) and 10 (August 2000). For semi-volatile (EPA Methods 625/8270C) organic compounds, volatile (EPA Methods 624/8260B) organic compounds, and pesticides (EPA Methods 608/8081 and 614/8141A), only those pollutants that were detected in the influent, effluent, or sludge are listed. Refer to Appendices A and B for a complete listing of toxic pollutants and pesticides analyzed. A number of the constituents were found only in the sludge. Pollutants found in the influent were often detected in the effluent, and vice versa. In general, pollutant concentrations were low. Many of the concentrations reported for the June 2000 sampling in particular were below detection limits. Also, the analyte list for the August 2000 sampling included dissolved metals in addition to total metals as required by the new NPDES permit.

Table 8. Discharge Monitoring Data for Influent and Effluent Non-Metals.

Month	Flow Rate (MGD)	Temperature Average (°C)		pH Minimum/ Maximum (pH)		Cl ₂ , Total Residual Average (mg/L)		D.O. Average (mg/L)		BOD ₅ Average (mg/L)		Total Susp. Solids Average (mg/L)		Fecal Coliform Average (MPN/100 mL)	
		INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF
01/00	30.4	10.8	11.2	7.0/7.5	6.8/7.4	NA	0.7	NA	6.0	243	142	229	44	NA	42
02/00	29.9	10.6	10.9	7.2/7.8	7.0/8.0	NA	0.7	NA	5.9	244	132	255	45	NA	157
03/00	30.4	10.6	11.0	7.2/8.2	7.0/7.7	NA	0.8	NA	5.5	228	129	259	49	NA	44
04/00	33.8	10.4	10.8	7.1/7.6	6.9/7.4	NA	0.8	NA	6.2	209	124	230	48	NA	11
05/00	29.7	11.7	12.1	7.1/7.7	7.0/7.4	NA	0.7	NA	5.8	241	137	260	44	NA	40
06/00	27.5	13.3	13.7	7.0/7.6	7.0/7.4	NA	0.7	NA	4.6	270	140	295	52	NA	9
07/00	28.0	14.5	15.1	6.9/7.6	6.8/7.2	NA	0.7	NA	4.5	255	128	265	43	NA	135
08/00	28.1	15.0	15.6	7.1/7.6	6.9/7.5	NA	0.8	NA	4.9	228	127	262	47	NA	87
09/00	29.0	15.2	15.5	6.8/7.6	6.7/7.5	NA	0.8	NA	5.4	233	131	276	50	NA	45
10/00	29.0	14.5	14.6	6.9/7.6	6.6/7.4	NA	0.8	NA	5.8	249	140	260	52	NA	252
11/00	28.6	13.5	13.8	7.0/7.6	6.8/7.3	NA	0.8	NA	6.2	250	144	220	39	NA	100
12/00	28.5	12.5	12.8	6.9/7.5	6.9/7.3	NA	0.8	NA	6.4	273	143	264	41	NA	71
Average	29.4	12.7	13.1	6.8/8.2^a	6.6/8.0^a	---	0.8	---	5.6	243	135	257	46	---	83
Percent Removal		---		---		---		---		44		82		---	

^a Yearly (minimum-maximum)

NA Not analyzed

--- Not applicable

Table 9. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled 6 - 7 June 2000.

Pollutant	Influent^{a,b} (µg/L)	Effluent^{a,b} (µg/L)	Sludge^a (µg/g)	Percent Removal
VOLATILES (EPA Methods 624/8260B)				
1,1,2,2-Tetrachloroethane	1.6	ND(1.0)	ND(0.68)	38
Chloroform	2.9	3.8	ND(0.68)	-31
1,3-Dichlorobenzene	2.6	1.8	ND(0.68)	31
1,4-Dichlorobenzene	1.1	ND(1.0)	ND(0.68)	9
Ethylbenzene	1.4	1.0	ND(0.68)	29
Methylene Chloride	5.8	3.8	ND(0.68)	34
Tetrachloroethene	1.5	1.3	ND(0.68)	13
Toluene	15	10	ND(0.68)	33
VOLATILES (EPA Method 602)				
Benzene	ND(0.50)/ND(0.50)	ND(0.50)/ND(0.50)	NT	---/---
Ethylbenzene	ND(0.50)/ND(0.50)	ND(0.50)/ND(0.50)	NT	---/---
Toluene	8.1/8.5	7.0/6.8	NT	14/20
Xylenes	ND(0.50)/ND(0.50)	10/6.3	NT	-1900/-1160
1,2 Dichlorobenzene	3.1/3.2	ND(0.50)/11	NT	84/-244
1,3 Dichlorobenzene	4.0/3.6	10/11	NT	-150/-206
1,4 Dichlorobenzene	15/15	15/24	NT	0/-60
SEMI-VOLATILES (EPA Methods 625/8270C)				
Phenol	38	ND(10)	ND(9.1)	74
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	118000	21200	NT	82
Total Petroleum Hydrocarbons (EPA 1664-SGT-HEM)	18000	ND(5000)/ND(5000)	NT	72/72
Total Aromatic Hydrocarbons as BETX from EPA Method 602	9.6/10	18/14.1	NT	-88/-41

Table 9. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled 6 - 7 June 2000. (continued)

Pollutant	Influent ^{a,b} (µg/L)	Effluent ^{a,b} (µg/L)	Sludge ^a (µg/g)	Percent Removal
METALS (TOTAL)				
Antimony	ND(10)	ND(10)	2.4	---
Arsenic	ND(3)	ND(3)	4.4	---
Beryllium	ND(0.1)	ND(0.1)	0.29	---
Cadmium	ND(5)	ND(5)	2.7	---
Chromium	ND(10)	ND(10)	22	---
Copper	75	54	174	28
Lead	6.4	4.8	28	25
Mercury	0.2	0.1	0.7	50
Nickel	ND(20)	ND(20)	21	---
Selenium	ND(10)	ND(10)	0.61	---
Silver	6.3	5.3	15.8	16
Thallium	ND(10)	ND(10)	0.84	---
Zinc	150	77	337	49
PESTICIDES (EPA Methods 608/8081, 614/8141A)				
alpha-Chlordane	ND(0.50)	ND(0.50)/ND(0.50)/ ND(0.50)	0.050	---
gamma-Chlordane	ND(0.50)	ND(0.50)/ND(0.50)/ ND(0.50)	0.042	---
4,4'-DDD	ND(0.020)	ND(0.020)/ND(0.020)/ ND(0.020)	0.012	---
OTHER COMPONENTS				
Asbestos ^c	ND(1.977)	ND(1.977)	ND	---
Cyanide	ND(10)	10	0.7	0

^a Detection limits are included in parentheses for non-detected (ND) values

^b Duplicate field sample analysis and/or duplicate laboratory analysis provided (value/duplicate values)

^c Asbestos reported in million fibers/L (influent or effluent) or present or none detected (sludge)

--- Not applicable (not calculated)

ND None detected

NT Not tested

Table 10. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled 14 - 15 August 2000.

Pollutant	Influent^{a,b} (µg/L)	Effluent^{a,b} (µg/L)	Sludge^a (µg/g)	Percent Removal
VOLATILES (EPA Methods 624/8260B)				
Benzene	ND(1.0)	4.3	ND(0.78)	-330
Bromomethane	ND(2.0)	ND(2.0)	7.1	---
Chloroform	2.6	3.3	ND(0.78)	-27
Chloromethane	ND(2.0)	6.2	ND(1.6)	-210
Ethylbenzene	2.7	4.1	6.4	-52
Methylene Chloride	1.1	1.8	ND(0.78)	-64
Tetrachloroethene	1.4	1.4	ND(0.78)	0
Toluene	13	27	3.4	-108
Trichloroethene	1.1	ND(1.0)	ND(0.78)	9
VOLATILES (EPA Method 602)				
Benzene	1.1	5.3/5.3	NT	-382/-382
Ethylbenzene	9.8	6.5/6.3	NT	34/36
Toluene	11	23/23	NT	-109/-109
1,2 Dichlorobenzene	3.4	9.5/8.0	NT	-179/-135
1,4 Dichlorobenzene	1.3	7.1/6.3	NT	-446/-385
Xylenes	42	37/37	NT	12/12
SEMI-VOLATILES (EPA Methods 625/8270C)				
bis (2-Ethylhexyl) phthalate	16	10	ND(52)	38
HYDROCARBONS				
Oil & Grease (EPA 1664-HEM)	45300	20300	NT	55
Total Petroleum Hydrocarbons (EPA 1664-SGT-HEM)	ND(5000)	ND(5000)	NT	---
Total Aromatic Hydrocarbons as BTEX from EPA Method 602	63.9	71.8/71.6	NT	-12/-12

Table 10. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled 14 - 15 August 2000. (continued)

Pollutant	Influent^{a,b} (µg/L)	Effluent^{a,b} (µg/L)	Sludge^a (µg/g)	Percent Removal
METALS				
Antimony (Total)	ND(10)/ND(10)	ND(10)	2.2	---/---
Antimony (Dissolved)	ND(10)	ND(10)	NT	---
Arsenic (Total)	3	3	4.2	0
Arsenic (Dissolved)	3	3	NT	0
Beryllium (Total)	ND(0.1)	ND(0.1)	0.15	---
Beryllium (Dissolved)	ND(0.1)	ND(0.1)	NT	---
Cadmium (Total)	ND(5)	ND(5)	2.9	---
Cadmium (Dissolved)	5	6	NT	-20
Chromium (Total)	10	10	23	0
Chromium (Dissolved)	ND(10)	ND(10)	NT	---
Copper (Total)	84	53	307	37
Copper (Dissolved)	22	39	NT	-77
Lead (Total)	15	8	53.4	47
Lead (Dissolved)	3	7	NT	-133
Mercury (Total)	0.3	ND(0.1)	2.3	67
Mercury (Dissolved)	ND(0.1)	ND(0.1)	NT	---
Nickel (Total)	ND(20)	ND(20)	25	---
Nickel (Dissolved)	ND(20)	20	NT	0
Selenium (Total)	ND(10)/ND(10)	ND(10)	1.5	---/---
Selenium (Dissolved)	ND(10)	ND(10)	NT	---
Silver (Total)	9.3	5.3	27.5	43
Silver (Dissolved)	1.5	0.4	NT	73
Thallium (Total)	ND(10)/ND(10)	ND(10)	ND(0.3)	---/---
Thallium (Dissolved)	ND(10)	ND(10)	NT	---
Zinc (Total)	130	80	633	38
Zinc (Dissolved)	30	50	NT	-67

Table 10. Toxic Pollutants and Pesticides Detected in the Influent, Effluent, and Sludge, Sampled 14 - 15 August 2000. (continued)

PESTICIDES (EPA 608/8081, 614/8141A)				
gamma-Chlordane	ND(0.50)	ND(0.50)/ND(0.50)	0.030	---/---
4,4'-DDT	ND(0.020)	ND(0.020)/ND(0.020)	0.016	---/---
4,4'-DDE	ND(0.020)	0.020/ND(0.020)	ND(0.0091)	0/---
4,4'-DDD	0.022	ND(0.020)/ND(0.020)	0.250	9/9
ENTEROCOCCI BACTERIA (SM 9230B)				
Enterococci ^c	NT	>2419.2/>2419.2 ^d	NT	---
OTHER COMPONENTS				
Asbestos ^e	160	46	ND	71
Cyanide	ND(10)	10.8	0.9	-8

a Detection limits are included in parentheses for non-detected (ND) values

b Duplicate field sample analysis or duplicate laboratory analysis provided (value/duplicate value)

c Enterococci reported in MPN/100 mL

d Two replicate samples collected for enterococci analysis

e Asbestos reported in million fibers/L (influent or effluent) or present or none detected (sludge)

--- Not applicable

ND None detected

NT Not tested

Percent removal rates shown in these tables were computed from influent and effluent concentration values, with the reporting limit concentration used for pollutants reported as not detected (ND). Percent removal was not calculated when both influent and effluent concentrations were not detected (i.e., when compounds were only detected in sludge samples) or if either the influent or effluent average value fell below the limit. Where several laboratory duplicate analyses were performed for a parameter, a percent removal is provided for each duplicate. For summed values, such as the total aromatic hydrocarbons as BETX from Method 602, the detection limit was used for values reported as not detected (ND).

Some of the pollutant removal rates were actually negative values due to the higher concentrations found in the effluent or where a compound was detected in the effluent but not the influent. Both positive and negative removals can be caused by effluent samples being more homogenous due to mixing in the clarifiers, whereas detecting a point-source pollutant in the influent is more haphazard. Also, there is a residence time for the effluent in the WWTF, therefore the influent sample doesn't correspond directly with the effluent sample.

Oil and grease were measured in the influent and effluent in 2000 using EPA 1664 HEM which has replaced SM 5520B due to the federal ban on freon. In addition, total petroleum hydrocarbons in the influent and effluent were analyzed using EPA 1664 SGT-HEM (silica gel treated n-hexane extractable material) which has replaced the old methods SM 503E/5520F. Total aromatic hydrocarbons as BETX (EPA 602) and total aqueous hydrocarbons (EPA 602 + EPA 610) were also sampled in the effluent as part of the receiving water program. Oil and grease concentrations were typical of that seen in the past with effluent concentrations were in the range of 20-22 mg/L, whereas total petroleum hydrocarbons were below detection limits in the effluent. Both the TAH and TAqH were found to be very low in both the influent and effluent and in general substantially less than the MAEC. Refer to Section 5.1 for further discussion of the significance of the total hydrocarbon values.

The new AWQS have site-specific criteria for the Point Woronzof area that are based on dissolved metals in the receiving water. These SSWQC were utilized to determine the MAEC (the value specified as the receiving water limit and/or permit limit multiplied by the initial dilution of 143:1 after taking into account the natural background concentration). Both total and dissolved concentrations of metals in the effluent were then compared to the MAECs.

Total metals concentrations were generally found to be low. Effluent concentrations of total antimony, beryllium, cadmium, nickel, selenium, and thallium were below detection limits during both sampling periods. Total metals such as arsenic, chromium, and mercury were seen in the effluent during one of the sampling events at relatively low levels. Other total metals such as effluent copper, lead, silver, and zinc were seen in the effluent during both sampling events, but at very low levels when compared to their respective MAECs.

In addition to the total metals analyses, dissolved metals were determined during the August 2000 sampling as required by the 2000 NPDES permit. Dissolved metals concentrations for antimony, beryllium, chromium, mercury, selenium, and thallium were found to be below detection limits. The concentration for dissolved copper was found to be the highest of any of the metals with respect to its MAEC, but still an order of magnitude less than the limit. Other dissolved metals were detected, but at very low levels with respect to their MAECs.

The concentrations of cyanide in influent were less than the detection limit of 10 µg/L during both the June 2000 and August 2000 sampling events. The concentration of cyanide in the effluent were measured at 10 and 10.8 during the June 2000 and August 2000 samplings, respectively. The MAEC for cyanide is 288 µg/L.

The types and concentrations of measured organic compounds varied considerably between the two sampling periods. Methylene chloride, a common laboratory reagent, was detected in all of the water matrix (influent/effluent) samples, but was not detected in the laboratory method blanks. Other compounds that were detected in both the influent and effluent samples during at least one of the sampling events included benzene; bis(2-ethylhexyl)phthalate; 1,2-, 1,3-, and 1,4-dichlorobenzene; chloroform; ethylbenzene; tetrachloroethene; and toluene. None of these compounds were detected in the laboratory method blanks. Other compounds such as chloromethane; phenol; 1,1,2,2-tetrachloroethane; trichloromethene; and xylenes were found in either the influent or effluent during only one of the sampling events. With the exception of toluene and ethylbenzene during the June 2000 sampling, these same compounds were not detected in the sludge. The only other organic compound detected in the sludge was bromomethane during the August 2000 sampling; this compound was not detected in the influent or effluent during the same time period.

The only pesticides that were detected in the influent or effluent were 4,4'-DDD, which was detected just above the detection limit in the August 2000 influent sample, and 4,4'-DDE, which was found at the detection limit in the effluent during the same sampling event. Sludge samples were found to contain gamma-chlordane and 4,4'-DDD during both sampling events, alpha-chlordane during the June 2000 event, and 4,4'-DDT during the August 2000 sampling. No other pesticides were detected in the influent, effluent, or sludge during either sampling event. For a complete list of the various pesticide analytes, refer to Appendices A2 and B2.

Asbestos was detected in influent and effluent but not in the sludge during the June 2000 sampling event. No asbestos was detected in the influent, effluent, or sludge samples for the August 2000 sampling event.

The 2000 NPDES permit calls for the analysis of enterococci bacteria in effluent once per year in conjunction with the receiving water sampling. The enterococci in the effluent was reported as >2419.2 for both of the replicates taken on 16 August 2000, as reported in Table 10.

3.1.3 Pretreatment Monitoring Data

As part of the new 2000 NPDES permit, AWWU is to conduct pretreatment monitoring twice per year in conjunction with the toxic pollutant and pesticide analyses. This monitoring includes 3 consecutive days of 24-hr composite sampling of the influent and effluent. Pretreatment analyses include cyanide and a suite of metals that are analyzed as both total and dissolved. Since the June 2000 sampling was conducted under the 1985 permit before this requirement was in place, only one pretreatment sampling was conducted this year as part of the August 2000 sampling effort. Results of the pretreatment monitoring are presented in Table 11.

Metals concentrations for the first day of the pretreatment sampling were already discussed in Section 3.1.2 as part of the toxic pollutant and pesticide analyses. Metals concentrations for the two subsequent days were similar to those seen on the first day of sampling. Of all the metals, the

Table 11. Pretreatment Monitoring Data for Influent and Effluent Metals and Cyanide. Concentrations are in µg/L.

Month/ Day	Parameter	Arsenic		Beryllium*		Cadmium		Copper		Cyanide		Lead	
		Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Aug 14	Dissolved	3	3	<0.1	<0.1	5	6	22	39	NA	NA	3	7
	Total	3	3	<0.1	<0.1	<5	<5	84	53	<10	10	15	8
Aug 15	Dissolved	<3	3	<0.1	<0.1	5	5	19	35	NA	NA	1	1
	Total	3	3	<0.1	<0.1	<5	<5	88	51	<10	<10	7	3
Aug 16	Dissolved	3	3	0.1	<0.1	5	6	24	38	NA	NA	2	2
	Total	4	3	<0.1	<0.1	<5	<5	83	56	<10	<10	8	3
Month/ Day	Parameter	Mercury		Nickel		Silver		Zinc		Chromium			
		Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent		
Aug 14	Dissolved	<0.1	<0.1	<20	20	1.5	0.4	30	50	<10	<10		
	Total	0.3	<0.1	<20	<20	9.3	5.3	130	80	10	10		
Aug 15	Dissolved	<0.1	<0.1	<20	<20	1.8	0.6	20	30	<10	<10		
	Total	0.2	<0.1	<20	<20	9.0	5.3	160	80	10	10		
Aug 16	Dissolved	<0.1	0.1	<20	<20	2.2	0.6	20	40	<10	<10		
	Total	0.4	0.1	<20	<20	9.4	8.0	150	70	10	<10		

* Not required by Permit

NA Not applicable

dissolved copper and mercury concentrations in the effluent were the highest but still an order of magnitude less than their respective MAECs. Dissolved copper was found to range from 35 to 38 µg/L compared to the MAEC of 319 µg/L, and dissolved mercury was measured at 0.1 µg/L in one sample compared to its MAEC of 2.73 µg/L. Other metals and cyanide were found to be substantially less than their respective MAECs.

3.1.4 Whole Effluent Toxicity Testing Results

Quarterly WET testing was conducted as required under the new NPDES permit during the third and fourth quarters of calendar year 2000. WET testing was not required under the prior NPDES permit, therefore no testing was conducted during the first two quarters of the year. WET testing was conducted on one vertebrate and two invertebrate species. The vertebrate test was a 72-hr survival and growth bioassay on a topsmelt, *Atherinops affinis*. The invertebrate tests included a 48-hr survival and development test on a bivalve mussel, *Mytilus galloprovincialis*, and a 24-hr echinoderm fertilization test on a purple sea urchin, *Strongylocentrotus purpuratus*.

The WET tests were performed on 24-hr flow composite effluent samples. Testing was conducted on five effluent dilution series (0.175, 0.35, 0.70, 1.4, and 2.8 %) plus a control where the 0.70 % concentration corresponded to the edge of the ZID. The third quarter WET testing was performed on samples collected between 24-29 September 2000, and consisted of three separate 24-hr composites. The fourth quarter sampling was conducted on samples collected from 15-16 October 2000 for the sea urchin test and from 29 October to 3 November 2000 for the bivalve and topsmelt bioassays. A summary of the tests results is presented in Table 12 as the lowest observed effect concentration (LOEC), no observed effect concentration (NOEC), and in chronic toxicity units (TUc), where TUc = 100/NOEC. Detailed results in the form of descriptive laboratory reports that present all data in tabular form along with statistical analyses, QA/QC information, and reference toxicant tests are presented in Appendix C.

Table 12. Summary of WET Test Data from Calendar Year 2000.

Toxicity Test	LOEC	NOEC	TUc
3rd Qtr 2000 WET Tests			
Topsmelt (survival & growth)	>2.8 %	>2.8 %	<35.7
Bivalve (survival & development)	2.8 %	1.4 %	71.4
Echinoderm (fertilization)	>2.8 %	>2.8 %	<35.7
4th Qtr 2000 WET Tests			
Topsmelt (survival & growth)	>2.8 %	>2.8 %	<35.7
Bivalve (survival & development)	2.8 %	1.4 %	71.4
Echinoderm (fertilization)	>2.8 %	>2.8 %	<35.7

Results of the topsmelt bioassays showed that no concentration of effluent tested produced significant mortality or significant decreased growth of topsmelt larvae when compared to the control for either of the tests that were conducted in 2000. All test validity criteria were met and reference toxicant tests were within laboratory control chart limits which indicate typical sensitivity of the test populations for both tests.

The results of the bivalve mussel larvae bioassay indicated statistically significant reduced survival and normal development of the test organisms at the highest effluent concentration tested for both of the tests conducted during 2000. The TUC for both of the tests was reported as 71.4 compared to a permit maximum of 143 which would trigger additional testing requirements. No additional action was required. All test validity criteria were met and reference toxicant test results were within laboratory control chart limits for both tests which indicate typical sensitivity for the test population.

Results of the echinoderm fertilization bioassays showed that no concentration of effluent tested produced significantly reduced egg fertilization when compared to the seawater-only control for either of the tests that were conducted in 2000. All test validity criteria were met and reference toxicant tests were within laboratory control chart limits which indicate typical sensitivity of the test populations for both tests.

In summary, of the three test species, the bivalve *Mytilus galloprovincialis* was found to be the most sensitive for the first two suites of tests. The NPDES permit requires quarterly WET testing to continue on the most sensitive species after the first three suites of tests with an annual rescreening of all three species.

3.1.5 Part 503 Sludge Monitoring Data

The AWWU operates a sludge incinerator at the Point Woronzof WWTF . The sludge incinerator is subject to regulation under 40 CFR Part 503—*Standards for the Use or Disposal of Sewage Sludge*. Sludge was monitored monthly prior to August 2000 as a requirement of the facility's prior NPDES permit. The reissued NPDES permit, effective 2 August 2000, requires sludge monitoring twice per year as part of the "Toxic Pollutants and Pesticides/Pretreatment" sampling requirements.

There are no Part 503 monitoring requirements included in the reissued permit. EPA Region 10's current policy is to remove these requirements from NPDES permits with the intention of writing "sludge only" permits in future. However, the Part 503 regulations are "self-implementing"; that is, the facility is required to meet the monitoring requirements in the regulation whether they are specifically included in a permit or not. The 40 CFR Part 503 requires that AWWU submit the sludge monitoring results for the calendar year, along with other incinerator operational information, by February 19 of each year. This submittal will take the form of a separate report; however, for completeness and for comparison purposes, this information has been included here also.

Results of the sludge monitoring for metals for the year are presented in Table 13. Metals concentrations were low and very similar to those seen historically. The only metal that has historically been elevated for some sampling events is arsenic. In 2000, the highest concentration of arsenic in the sludge was 4.8 mg/kg compared to the prior permit limit of 95.8 mg/kg. As mentioned above, no permit limits exist in the reissued permit.

Table 13. Part 503 Discharge Monitoring Data for Sludge Metals. Concentrations are in mg/kg dry weight. All metals are reported as total metals.

Month	Flow Rate (MGD)	Arsenic	Beryllium	Cadmium	Chromium	Lead	Mercury	Nickel
01/00	30.4	2.1	0.09	2.1	16	30	1.2	15
02/00	29.9	2.6	0.09	2.6	18	35	3.2	21
03/00	30.4	3.0	0.10	3.0	18	34	1.6	13
04/00	33.8	4.4	0.19	2.2	19	39	0.9	23
05/00	29.7	3.7	0.19	2.0	18	48	2.0	22
06/00	27.5	4.8	0.11	3.2	21	37	0.8	27
07/00	28.0	3.6	0.09	1.8	12	24	1.7	12
08/00	28.1	4.2	0.15	2.9	23	53	2.3	25
09/00	29.0	NT	NT	NT	NT	NT	NT	NT
10/00	29.0	4.7	0.13	3.1	49	35	1.3	21
11/00	28.6	NT	NT	NT	NT	NT	NT	NT
12/00	28.5	2.8	0.11	2.5	22	34	1.1	27
Average	29.4	3.6	0.13	2.5	22	37	1.6	21

MGD Million gallons/day

NT Not tested

3.2 RECEIVING WATER QUALITY MONITORING RESULTS

Water quality sampling of the receiving water was conducted on 14 and 16 August 2000. Due to high wind and wave conditions, sampling could not be performed as planned on 15 August 2000. Sampling results are contained in the following subsections.

3.2.1 Plume Dispersion Sampling

Drogue Tracking Results

Drogues were released on 14 August 2000 at the control station and 16 August 2000 at the ZID station for the ebb and flood tidal cycles. Three drogues were deployed during each tidal cycle.

Control Site

The Point MacKenzie control drogues were dropped and tracked on 14 August 2000. The predicted tidal range during the flood tide was 30.5 ft. Tidal information is provided in Figure 5 and Table 14 (Micronautics, Inc. Tide 1: Rise and Fall®, 2000). A composite of the three drogue trajectories is presented in Figure 6.

The first drogue (C1) was released at 14:59 Alaska Daylight Time (ADT), nearly 23 minutes after slack water, and recovered at 16:40 ADT. The first drogue traveled northeast parallel to the shoreline, the drogue was then caught in an eddy and looped back towards shore and eventually became grounded approximately 2 nautical miles from its release site. The average speed of this drogue over the entire track was 73 centimeters/second (cm/s). The second drogue (C2) was released at 17:00 ADT, approximately 2 ½ hours into the flood tidal cycle, and tracked until recovery at 18:12 ADT. This drogue had an average speed of 180 cm/s over the entire track and moved towards the northwest offshore of the first drogue and then northerly after passing Cairn Point. The third control drogue (C3) was released at 19:02 ADT, 4 ½ hours after high slack water. The drogue traveled northeast into the central channel with an average speed of 157 cm/s. The drogue was recovered at approximately one hour after release in mid channel west of Cairn Point.

ZID Site

The Point Woronzof ebb drogue drop and tracking cycles were performed on the morning and afternoon of 16 August 2000. The tidal range during ebb stage was 31.1 feet (Figure 7 and Table 14; Micronautics, Inc. Tide 1: Rise and Fall®, 2000). A composite of the ebb drogue deployments is depicted in Figure 8.

All three of the ebb drogues traveled one to two nautical miles in a southwesterly direction, with the last drogue traveling more directly south in along the shoreline. Due to vessel mechanical problems, the drogue tracking was initiated mid-way through the tidal cycle with the first drogue being deployed 2:46 minutes after high slack. No eddies were observed during these drogue drops. The first drogue tracked south of the shoal that is evident at low water one mile southwest of Point Woronzof. The second ebb drogues tracked directly over the shoal, and the third drogue tracked along the shoreline. The first ebb drogue (E1) was released at 11:26 ADT and tracked until 12:11, at which point it was recovered. The second ebb drogue (E2) was released at 12:30 ADT, almost

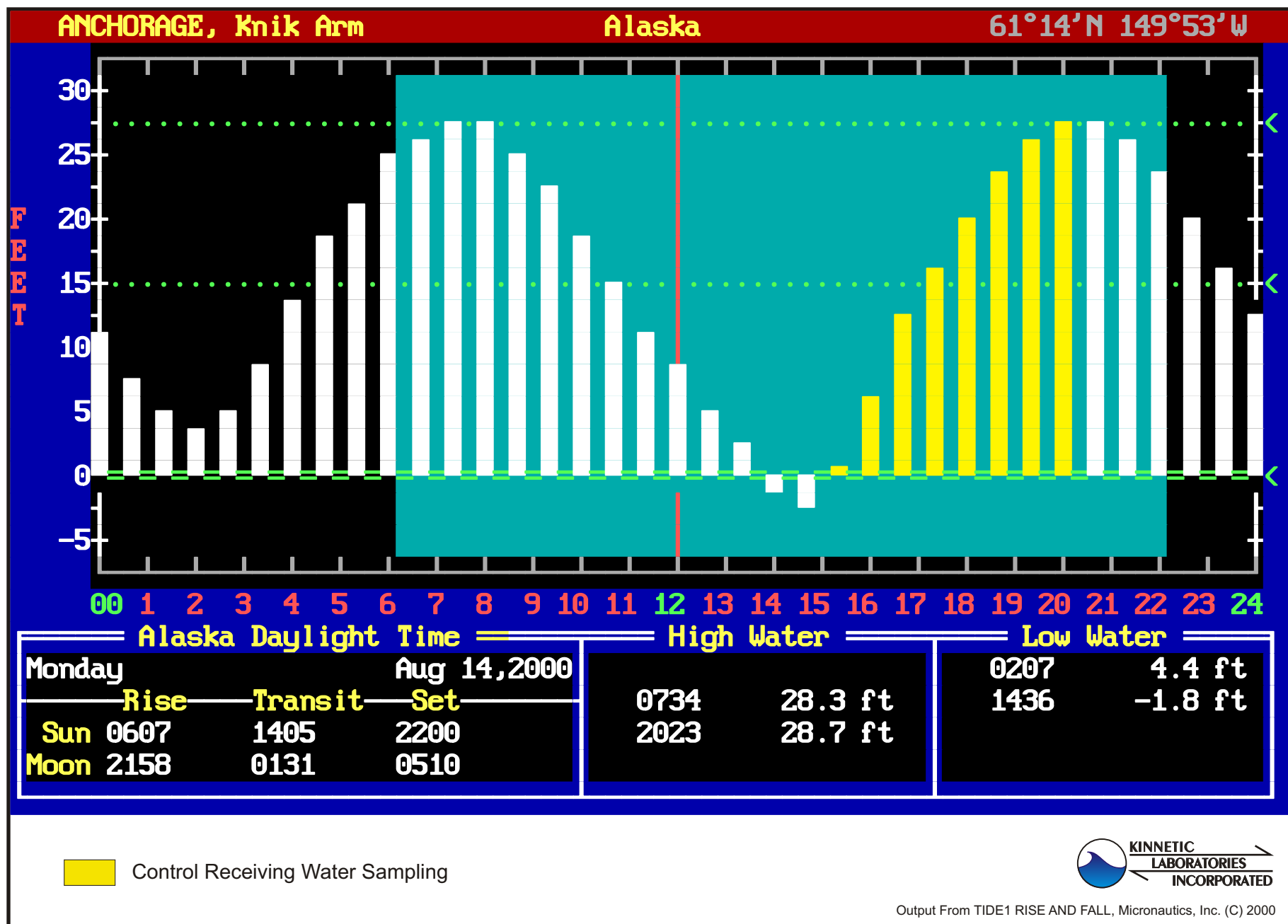


Figure 5. Tidal Information for Receiving Water Sampling, Control Tides.

Table 14. 2000 Drogue Tracking Information.

Date	Station	Tidal Information			Drogue No.	Release Time After Slack (Hours:Minutes)	Drogue Speed (cm/s)
		Slack Water (Alaska Daylight Time ^a ; Stage)	Direction	Range (Feet) ^b			
14 August 2000	CONTROL	14:36 LOW	FLOOD	30.5	C1	0:23	73
14 August 2000	CONTROL	14:36 LOW	FLOOD	30.5	C2	2:24	180
14 August 2000	CONTROL	14:36 LOW	FLOOD	30.5	C3	4:26	157
16 August 2000	ZID	08:40 HIGH	EBB	31.1	E1	2:46	115
16 August 2000	ZID	08:40 HIGH	EBB	31.1	E2	3:50	113
16 August 2000	ZID	08:40 HIGH	EBB	31.1	E3	5:42	49
16 August 2000	ZID	15:42 LOW	FLOOD	30.9	F1	0:08	39
16 August 2000	ZID	15:42 LOW	FLOOD	30.9	F2	1:39	87
16 August 2000	ZID	15:42 LOW	FLOOD	30.9	F3	3:00	109

^a Tide1: Rise and Fall®, Micronautics, Inc. 2000. (Knik Arm, Anchorage)

^b Predicted water level variations during tide.

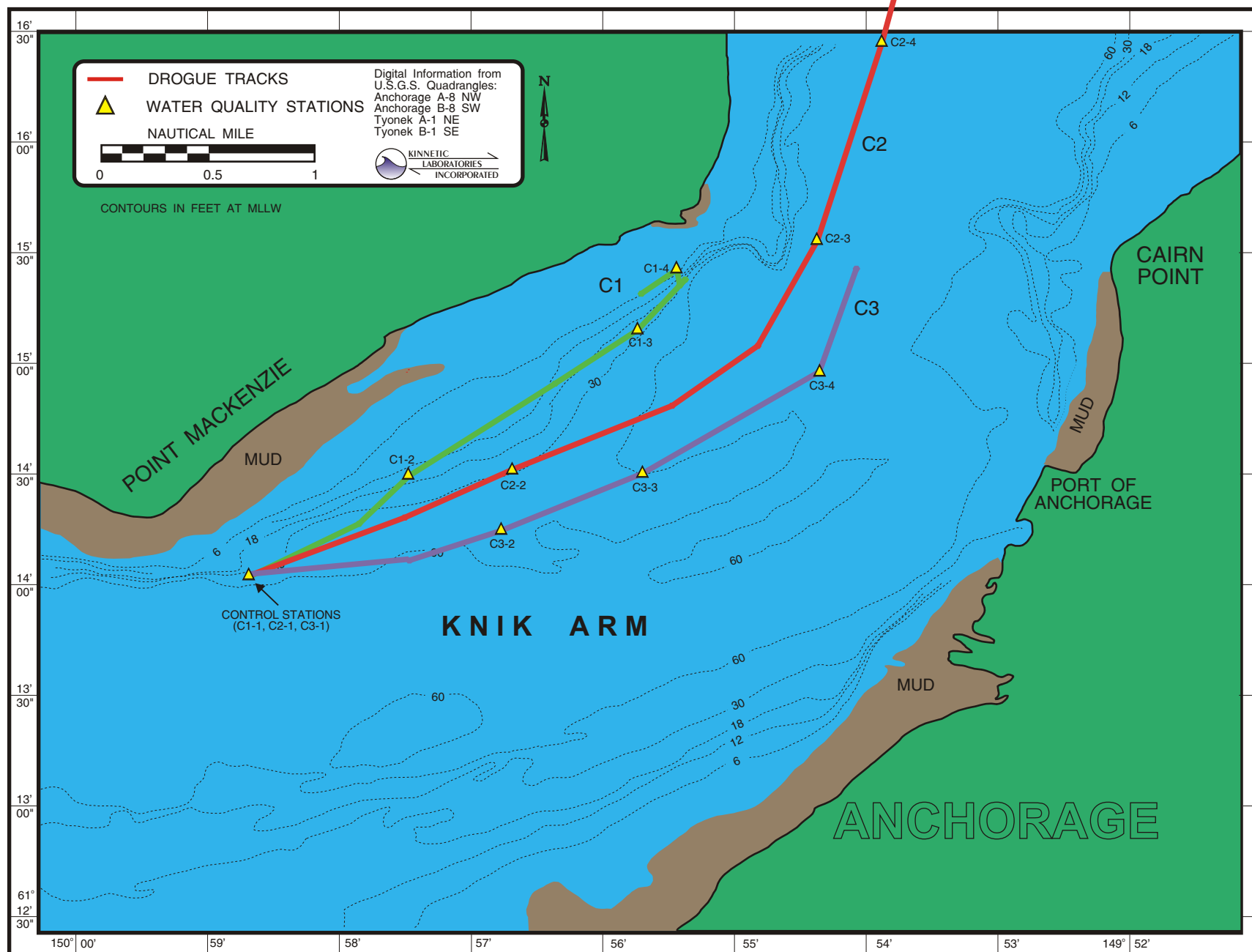


Figure 6. Summary of Control Drogue Tracks and Receiving Water Sampling Locations at Point MacKenzie, 14 August 2000.

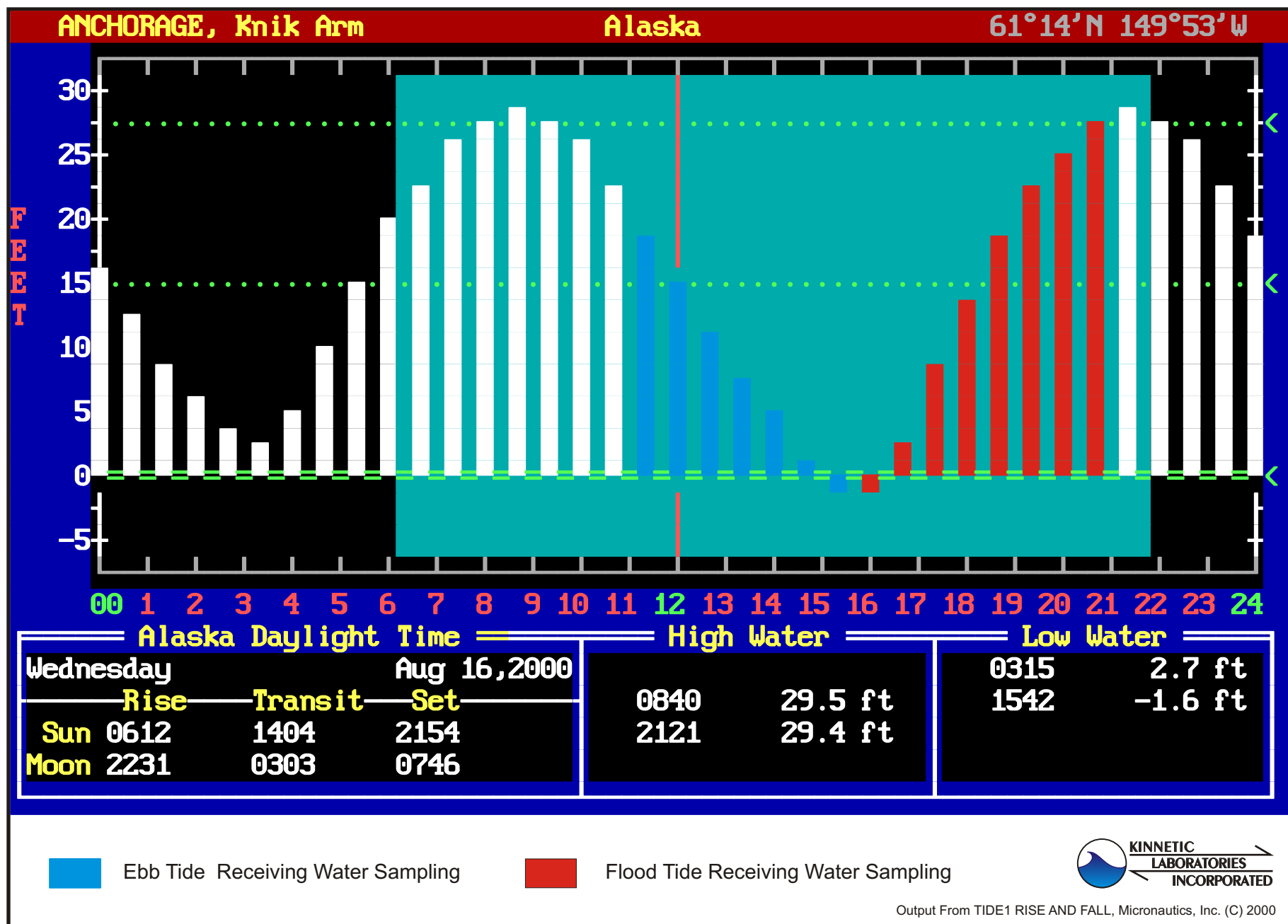


Figure 7. Tidal Information for Receiving Water Sampling, Ebb and Flood Tides.

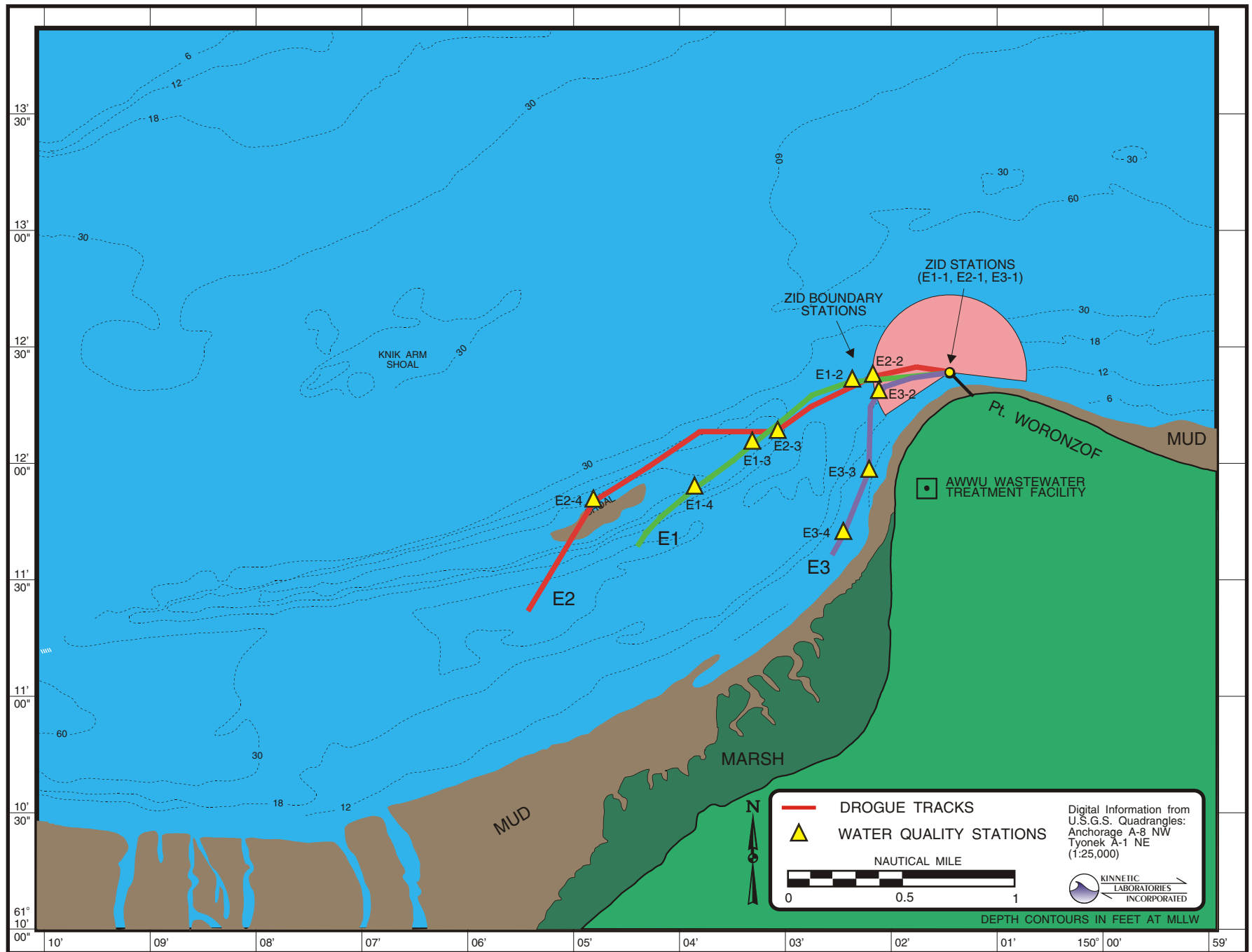


Figure 8. Summary of Ebb Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 16 August 2000.

four hours after high tide, and tracked until recovery at 13:34 ADT. The average speeds for these drogues were 115 and 113 cm/s, respectively. The third drogue (E3) was released at 14:22 ADT, over five hours after the high tide, and tracked until 15:28 ADT. The average speed of this drogue was 49 cm/s.

The flood drogue drop and tracking cycles at Point Woronzof were performed on the afternoon and evening of 16 August 2000. The predicted rise in water level was 30.9 ft for the flood cycle (Figure 7 and Table 14; Micronautics, Inc. Tide 1: Rise and Fall®, 2000). A composite of the three flood drogue tracking cycles is presented in Figure 9.

The first flood drogue (F1) was deployed on 25 August at 15:50 ADT, at low slack water at the outfall and tracked until 17:02 ADT, at which point it was recovered. This drogue traveled easterly along the shoreline on the lee side of Point Woronzof. The drogue traveled for approximately one nautical mile at an average speed of 39 cm/s. In the past, the first drogue has often encountered a clockwise eddy in the lee of Point Woronzof bringing it back towards shore. This eddy was not evident in 2000, however, the drogue did travel close to the shoreline.

The second flood drogue (F2) was deployed at 17:21 ADT, 1 ½ hours after low slack, and tracked until it was recovered at 18:14 ADT. The second drogue was transported to the east and slowly traveled back towards the shoreline approximately one and a half nautical miles from its release point. The second drogue had an average speed of 87 cm/s.

The third flood drogue (F3) was deployed at 18:42 ADT, three hours after high slack water, and tracked until recovery at 21:04 ADT. The third drogue traveled in a northeast direction further out from the shoreline with an average speed of 109 cm/s. The third drogue was tracked for five nautical miles to the northeast and was recovered one mile offshore and to the west of the Port of Anchorage.

Summary of Water Quality Data

The summer water quality sampling for all analysis types was conducted concurrently with the drogue dispersion studies on 14 and 16 August 2000. As discussed previously, three drogues were released per tidal cycle at the ZID for both ebb and flood tides and three at the control site for the flood tide only. Water samples and CTD measurements were to be obtained at four stations along each drogue's track prior to its grounding. In the reissued 2000 NPDES permit, the ZID boundary was located 650 m distance from the outfall diffuser. To accomplish the ZID site sampling, the vessel was positioned directly upcurrent from the diffuser and allowed to drift down across it. Upon reaching the outfall diffuser, the drogue was dropped and the within-ZID station sampled. The distance from the outfall diffuser was then monitored with the DGPS, and upon reaching 650 m distance from the diffuser, the ZID-boundary station was sampled. The third and fourth stations were then sampled along the drogue's path. Due to the high current speeds, anchoring of the vessel and sampling at each station was not practical or desirable for this type of water sampling.

Table 15 provides a summary of the water quality measurements obtained, where the station designation is represented by: drogue drop location (C=control, E=ebb, and F=flood), the first number represents the drogue number, and the second number represents the station along the drogue's path.

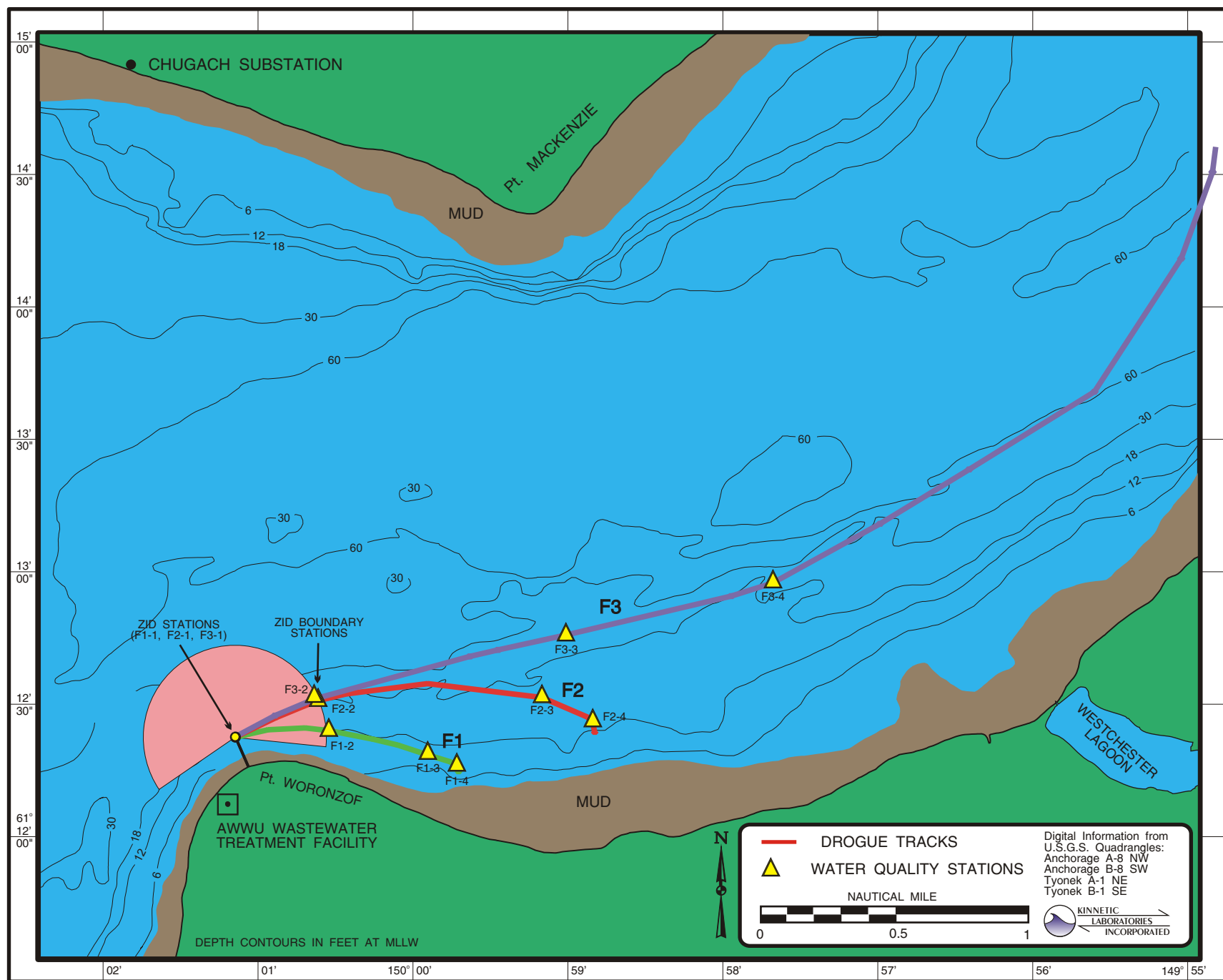


Figure 9. Summary of Flood Drogue Tracks and Receiving Water Sampling Locations at Point Woronzof, 16 August 2000.

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000.

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
AUGUST 14												
C1-1S	1459	61° 14' 03.2"	149° 58' 38.7"	0.5	13.9	6.27	7.92	9.43	270	20	<0.0089	<2.0
-1M				3.5	13.9	6.32	7.92	9.66	290			
-1B				6.5	13.9	6.43	7.89	9.51	410			
C1-2S	1518	61° 14' 30.6"	149° 57' 26.5"	0.5	13.9	6.40	7.96	9.58	380	15	<0.0089	<2.0
-2M				2.0	14.0	6.42	7.96	9.66	410			
-2B				4.0	14.0	6.47	7.96	9.71	405			
C1-3S	1540	61° 15' 10.2"	149° 55' 42.1"	0.5	13.9	6.18	7.90	9.39	260	15	<0.0089	7.0
-3M				12.5	13.8	6.22	7.95	9.47	410			
-3B				25.0	13.8	6.14	7.92	9.61	450			
C1-4S	1610	61° 15' 26.5"	149° 55' 24.3"	0.5	14.0	6.24	7.96	9.99	290	15	<0.0089	2.0
-4M				11.5	13.9	6.24	7.97	9.47	500			
-4B				23.0	13.8	6.20	7.98	10.02	380			
C2-1S	1700	61° 14' 03.7"	149° 58' 38.3"	0.5	14.6	6.47	7.92	9.32	250	10	<0.0089	<2.0
-1M				7.0	14.4	6.88	7.91	9.53	270			
-1B				14.0	14.2	6.93	7.77	9.48	470			
C2-2S(A)	1728	61° 14' 32.2"	149° 56' 39.3"	0.5	14.6	6.24	7.96	9.60	180	15	<0.0089	2.0
-2S(B)	1728			0.5	14.5	6.86	7.93	9.34	178	10		<2.0
-2S(C)	1728			0.5	14.6	6.70	7.88	9.66	180	10		2.0
-2M				9.0	14.3	7.00	7.96	9.48	260			
-2B				18.0	14.1	6.98	7.97	9.47	480			

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
C2-3S	1753	61° 15' 34.4"	149° 54' 20.1"	0.5	14.4	4.34	7.92	9.18	330	10	<0.0089	2.0
-3M				18.0	14.3	7.33	7.95	9.22	340			
-3B				36.0	14.3	7.34	7.96	9.33	400			
C2-4S	1808	61° 16' 27.9"	149° 53' 50.7"	0.5	14.4	7.33	7.94	9.41	380	10	<0.0089	2.0
-4M				12.5	14.3	7.35	7.94	9.31	360			
-4B				25.0	14.3	7.19	7.90	9.36	380			
C3-1S(A)	1902	61° 14' 02.5"	149° 58' 37.7"	0.5	14.6	7.97	7.94	9.37	340	<5	<0.0089	2.0
-1S(B)	1902			---	---	---	---	9.36	330	<5	<0.0089	2.0
-1S(C)	1902			---	---	---	---	9.32	330	<5	<0.0089	2.0
-1M				8.0	14.6	8.16	7.95	9.19	290			
-1B				15.5	14.5	8.45	7.94	9.35	340			
C3-2S	1920	61° 14' 15.8"	149° 56' 44.4"	0.5	14.5	7.65	7.91	9.38	280	5	<0.0089	<2.0
-2M				10.5	14.6	8.63	7.94	9.24	370			
-2B				20.5	14.6	8.62	7.94	9.28	440			
C3-3S	1932	61° 14' 31.3"	149° 55' 39.9"	0.5	14.6	8.71	7.94	9.29	310	10	<0.0089	4.0
-3M				11.0	14.6	8.87	7.94	9.38	400			
-3B				22.0	14.7	9.01	7.94	9.19	400			
C3-4S	1948	61° 14' 58.9"	149° 54' 19.3"	0.5	14.7	7.65	8.00	9.33	360	<5	<0.0089	<2.0
-4M				18.0	14.6	8.15	7.96	9.24	360			
-4B				35.5	14.6	8.64	7.96	9.31	360			

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
AUGUST 16												
E1-1S	1126	61° 12' 20.0"	150° 01' 17.7"	0.5	13.9	7.67	7.96	9.49	380	<5	<0.0089	4.0
-1M				5.0	13.9	7.70	7.92	9.39	380			
-1B				10.0	13.9	7.70	7.79	9.49	400			
E1-2S	1135	61° 12' 17.9"	150° 02' 14.0"	0.5	13.9	7.72	8.02	9.34	380	<5	<0.0089	13.0
-2M				8.0	13.9	7.81	8.03	9.30	380			
-2B				15.5	13.9	7.89	8.06	9.38	380			
E1-3S	1145	61° 12' 02.3"	150° 03' 09.9"	0.5	14.0	7.56	8.04	9.42	370	10	<0.0089	8.0
-3M				4.5	14.0	7.82	8.04	9.50	330			
-3B				9.0	13.9	7.82	8.00	9.46	370			
E1-4S	1155	61° 11' 51.2"	150° 03' 43.5"	0.5	14.0	7.66	8.05	9.44	360	10	<0.0089	11.0
-4M				3.0	14.0	7.84	8.05	9.41	330			
-4B				6.0	14.0	7.86	8.05	9.29	360			
E2-1S	1230	61° 12' 20.7"	150° 01' 17.1"	0.5	13.9	7.49	8.05	9.62	380	<5	<0.0089	2.0
-1M				4.0	13.9	7.53	8.05	9.43	370			
-1B				8.0	13.9	7.53	8.00	9.48	370			
E2-2S	1237	61° 12' 19.3"	150° 02' 00.2"	0.5	13.9	2.70	8.06	9.50	390	5	<0.0089	7.0
-2M				6.0	13.9	7.55	8.06	9.53	380			
-2B				12.0	13.9	7.55	8.06	9.48	390			

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
E2-3S	1252	61° 12' 05.5"	150° 02' 55.9"	0.5	13.5	5.39	8.06	9.49	390	15	<0.0089	2.0
-3M				5.0	13.9	7.53	8.06	9.49	400			
-3B				10.0	13.9	7.54	8.07	9.40	400			
E2-4S	1320	61° 11' 36.3"	150° 04' 41.5"	0.5	13.8	6.90	8.07	9.47	380	10	<0.0089	4.0
-4M				3.5	13.9	7.56	8.06	9.47	390			
-4B				7.0	13.9	7.56	8.06	9.52	400			
E3-1S	1422	61° 12' 20.6"	150° 01' 19.5"	0.5	14.0	5.69	8.07	9.48	300	10	<0.0089	9.0
-1M				2.0	13.9	7.01	8.07	9.53	290			
-1B				4.0	13.9	7.00	8.07	9.48	290			
E3-2S	1443	61° 12' 15.1"	150° 01' 56.4"	0.5	14.0	6.94	8.02	9.58	170	15	<0.0089	7.0
-2M				4.5	13.9	6.94	8.03	9.48	260			
-2B				9.0	13.9	6.92	8.06	9.41	350			
E3-3S	1508	61° 11' 55.6"	150° 02' 02.1"	0.5	14.0	7.04	8.06	9.60	130	15	<0.0089	2.0
-3M				2.0	13.9	6.98	8.07	9.58	300			
-3B				4.0	14.0	7.01	8.07	9.49	850			
E3-4S	1520	61° 11' 39.7"	150° 02' 16.7"	0.5	14.1	7.06	8.06	9.38	140	5	<0.0089	4.0
-4M				2.0	14.1	7.18	8.06	9.51	200			
-4B				3.5	14.2	7.23	8.06	9.60	230			

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
F1-1S	1550	61° 12' 20.8"	150° 01' 16.6"	0.5	14.7	7.06	7.84	9.18	290	20	<0.0089	130.0
-1M				1.5	14.5	7.77	8.00	9.23	580			
-1B				3.0	14.6	7.83	7.95	9.44	190			
F1-2S	1612	61° 12' 22.8"	150° 00' 33.6"	0.5	14.6	4.82	7.98	9.46	150	20	<0.0089	11.0
-2M				2.0	14.5	7.25	7.99	9.54	180			
-2B				3.5	14.5	7.20	8.00	9.50	300			
F1-3S	1630	61° 12' 15.3"	149° 59' 48.8"	0.5	14.3	4.39	8.05	9.56	220	10	<0.0089	4.0
-3M				2.0	14.3	7.05	8.05	9.59	220			
-3B				3.5	14.3	7.04	8.05	9.45	240			
F1-4S	1650	61° 12' 11.5"	149° 59' 35.5"	0.5	14.4	5.03	NA	9.42	190	15	<0.0089	2.0
-4M				1.5	14.4	7.11	NA	9.49	220			
-4B				2.5	14.4	7.11	NA	9.59	270			
F2-1S	1721	61° 12' 20.1"	150° 01' 17.5"	0.5	14.6	8.25	8.05	9.36	370	<5	<0.0089	13.0
-1M				3.0	14.6	8.26	8.04	9.44	190			
-1B				5.5	14.6	8.25	8.04	9.23	380			
F2-2S	1728	61° 12' 31.8"	150° 00' 39.6"	0.5	14.8	8.38	8.04	9.22	400	10	<0.0089	8.0
-2M				5.0	14.8	8.41	8.03	9.14	370			
-2B				10.0	14.8	8.38	8.08	9.30	420			

Table 15. Hydrographic and Water Quality Data, 14 and 16 August 2000. (continued)

Station Number	Time (ADT)	Latitude (North)	Longitude (West)	Depth (M)	Temp. ^b (°C)	Salinity ^b (‰)	pH ^b (units)	D.O. (mg/L)	Turbidity (NTU)	Color (units)	TRC (mg/L)	Fecal Coliform ^a
F2-3S	1754	61° 12' 33.0"	149° 58' 56.7"	0.5	14.6	5.60	8.04	9.35	260	15	<0.0089	8.0
-3M				4.5	14.4	7.94	8.04	9.34	400			
-3B				9.0	14.4	7.96	8.09	9.30	360			
F2-4S	1810	61° 12' 25.1"	149° 58' 33.6"	0.5	14.6	6.18	8.05	9.33	330	10	<0.0089	8.0
-4M				4.5	14.3	7.84	8.06	9.41	380			
-4B				9.0	14.3	7.83	8.06	9.32	330			
F3-1S	1842	61° 12' 20.8"	150° 01' 16.0"	0.5	14.2	8.00	8.04	9.29	290	<5	<0.0089	4.0
-1M				5.0	14.2	8.01	8.04	9.22	300			
-1B				9.5	14.2	7.85	8.05	9.19	300			
F3-2S	1848	61° 12' 32.3"	150° 00' 40.2"	0.5	14.2	8.02	8.04	9.20	280	10	<0.0089	2.0
-2M				7.0	14.2	8.01	8.05	9.37	290			
-2B				13.5	14.2	8.25	8.06	9.26	320			
F3-3S	1914	61° 12' 52.0"	149° 58' 45.6"	0.5	14.2	7.56	8.05	9.28	230	15	<0.0089	9.0
-3M				8.5	14.2	8.02	8.06	9.26	360			
-3B				17.0	14.1	7.98	8.07	9.49	370			
F3-4S	1945	61° 13' 08.0"	149° 57' 11.7"	0.5	14.2	7.82	8.05	9.48	260	15	<0.0089	4.0
-4M				13.5	14.1	8.42	8.05	9.21	470			
-4B				26.5	14.1	8.30	8.07	9.08	470			

^a Fecal coliform reported as MPN/100 mL

^b Values from CTD for 0.5 m depth taken as close to surface as possible

NA Not available

--- Samples not collected

The waters of the inlet are extremely well-mixed both vertically and horizontally, as indicated by the CTD data. During the survey, temperatures ranged from a minimum of 13.5°C to a maximum of 14.8°C. Salinities were found to vary from a minimum of 2.70 ppt to a maximum of 9.01 ppt. Salinities were generally found to increase slightly during the flood and decrease on the ebb, as is typical for estuaries. Dissolved oxygen values obtained from Winkler titrations ranged from 9.14 to 10.02 mg/L.

Values for pH ranged from 7.84 to 8.07 with no vertical stratification. Turbidity values for water samples collected during the monitoring ranged from a low of 130 Nephelometric Turbidity Units (NTU) to a high of 850 NTU.

Representative hydrographic profiles of water quality are presented for the second control drogue drop, Station C3-1, and the nearfield station on the third flood drogue, Station F3-2 (Figure 10). The water column was found to be generally well-mixed from the surface to the bottom at all stations. Refer to Appendix D5 for hydrographic profile plots from each water quality station.

Dissolved oxygen data were collected *in-situ* by the CTD as well as by performing the Winkler titration on water samples collected using the Niskin bottles. The DO results tabulated and summarized in the body of this report were those obtained from Winkler analysis. The DO concentrations obtained from *in situ* measurements were more variable and felt to be less accurate and were not utilized for this report, but are presented with the hydrographic profile data in Appendix D5.

Surface samples were obtained at each station for the analysis of color, TRC, and fecal coliform bacteria. Color values ranged from <5 to 20 color units on the platinum-cobalt scale. The maximum of 20 color units was seen once at one control station, C1-1, and at two flood stations, F1-1, and F1-2; other values were all at or below 15 color units.

All TRC concentrations were at or below the detection limit of 0.0089 mg/L. It should be noted that the method detection limit achievable for TRC analysis is higher than the State-specified limit of 0.002 mg/L (for salmonid fish). The average TRC concentrations of the effluent as reported in the Monthly Monitoring Report for the sampling dates 14 and 16 August 2000 were 0.7 mg/L for both days. The effluent TRC grab obtained at the same time as the effluent grab sampling was 0.87 mg/L.

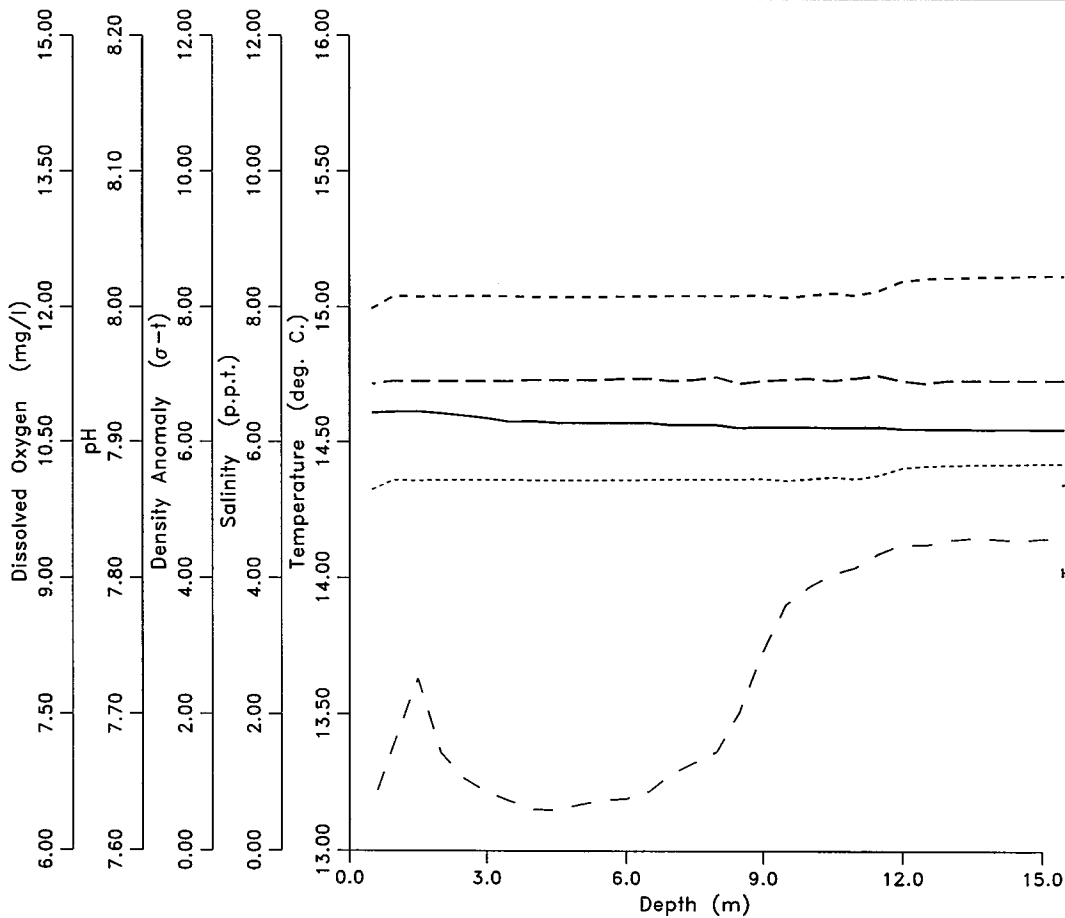
With the exception of Station F1-1, fecal coliform values were quite low this year and ranged from <2.0 to 130 MPN/100 mL. Station F1-1, which was sampled directly over the outfall at low slack water, had a fecal coliform concentration of 130 MPN/100 mL. Control stations ranged from <2.0 to 4.0 MPN/100 mL, outfall values during the ebb tide ranged from 2.0 to 11.0 MPN/100 mL, and outfall values during the flood tide ranged from 2.0 and 130.0 MPN/100 mL.

In addition to routine monitoring conducted at each water quality station, supplemental surface samples were collected from the first three stations along the first drogue trajectory for the ZID and control floods. A sample of final effluent was also obtained at the same time for comparison. Supplemental samples were analyzed for total aromatic hydrocarbons (TAH) defined as benzene, ethylbenzene, toluene, and total xylenes (BETX); polycyclic aromatic hydrocarbons (PAH); dissolved and total recoverable trace metals, cyanide, and TSS.

Control Station

MOA HYDROGRAPHIC DATA

Station: C3-1 Date: 8/14/00 Time: 19:02



Outfall Station

MOA HYDROGRAPHIC DATA

Station: F3-2 Date: 8/16/00 Time: 18:48

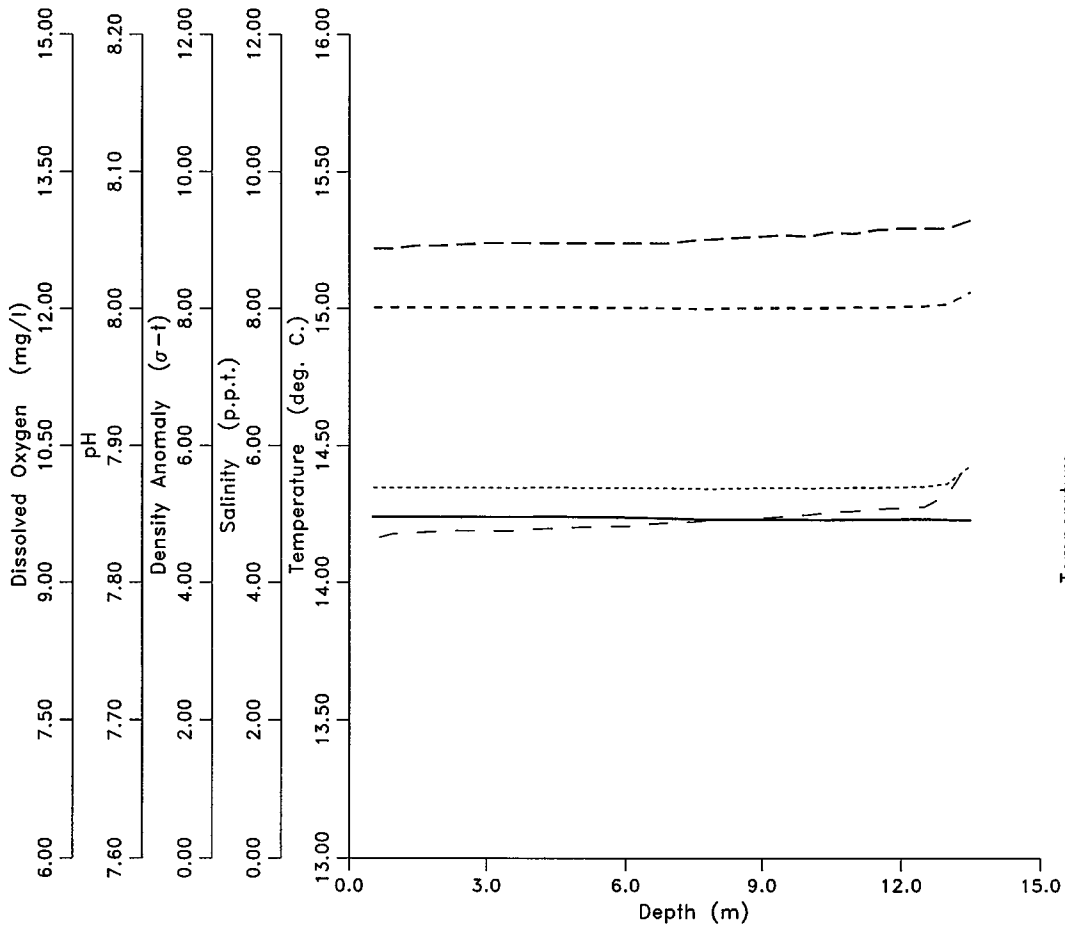


Figure 10. Sample Hydrographic Profiles from Control and Outfall Stations, August 2000.

Metals, cyanide, and TSS results for these samples are presented in Table 16. Total metals concentrations were quite variable, and differences between the outfall and control sites did not appear to exist that could be attributed to the discharge but were the result of differences in TSS concentrations. Control Station C1-2 was found to have the highest concentrations for each of the metals tested by total recoverable methodology. These relatively high concentrations can be attributed to high suspended sediment load at this station as evidenced by the 1100 mg/L of TSS. Similarly, for the outfall stations, Station F1-3 had the highest concentration for most total recoverable metals tested and also had the highest TSS concentration at 490 mg/L. Dissolved metals concentrations were found to be low and much less variable. All dissolved metals concentrations were found to be one to two orders of magnitude (10-100 times) less than the new State of Alaska SSWQC for the Point Woronzof area. Cyanide results from the ambient water stations were all below the detection limit of 2 µg/L. The cyanide concentration reported for the effluent samples was 29 µg/L. Total suspended solid results ranged from 150 to 1100 mg/L at the control stations, from 130 to 490 mg/L at the outfall stations, and was 750 mg/L for the effluent sample.

Hydrocarbon analyses results are presented in Table 17. Total aromatic hydrocarbons as BETX (EPA Method 602) was determined by summing benzene, ethyl benzene, toluene, and total xylenes. For values reported as ND, the MDL was used in the summation. Total aromatic hydrocarbons at the water quality stations were below the detection limit of 0.5 µg/L at all stations, well below the receiving water standard of 10 µg/L. The effluent sample had a concentration of 18.23 µg/L, significantly less than the MAEC of 1,140 µg/L. Total aqueous hydrocarbons (TAqH) as determined by PAH plus BETX was also determined for the six stations and effluent. All concentrations of individual PAHs were reported as below the detection limit of 1.01 µg/L, compared to receiving water quality criteria limit of 15 µg/L and the MAEC of 2,160 µg/L.

3.2.2 Intertidal Zone and Stream Bacterial Sampling

Intertidal zone and stream bacteriological sampling was performed on 16 August 2000. Intertidal zone sampling began approximately one hour prior to high tide at 20:20 ADT and was completed at 21:05 ADT. Two replicates were taken at all intertidal stations. Stream sampling was conducted from 12:35 to 13:12 ADT. In addition, an effluent sample was collected at the plant at 16:10 ADT. A summary of the sampling results is presented in Table 18. Refer to Figure 3 for a map of the station locations.

Fecal coliform concentrations ranged from 2.0 to 30.0 MPN/100 mL at the intertidal stations. Concentrations near the outfall, Stations IT-4 and IT-5, ranged from 2.0 and 17.0 MPN/100 mL for the four samples, very similar to other intertidal stations. The control station, IT-C4 located across the inlet near Point MacKenzie had concentrations of 4.0 and 23.0 for the two replicates. Fecal coliform concentrations found in the streams ranged from 4.0 MPN/100 mL at Ship Creek to 1600 MPN/100 mL at Fish Creek. The plant effluent sample taken on the same day was analyzed in duplicate and showed a value of 500 MPN/100 mL for both replicates.

Table 16. Concentrations of Dissolved Metals, Total Recoverable Metals, Cyanide, and Total Suspended Solids in Receiving Water and Effluent Samples. Values have not been blank corrected.

Station	Method	Ag	As	Be	Cd	CN	Cr	Cu	Hg	Ni	Pb	Sb	Se	Tl	Zn	TSS
		µg/L								mg/L						mg/L
F1-1S (WITHIN ZID)	Dissolved	0.0161	1.49	NA	0.0651	NA	0.254	0.831	0.367	0.731	0.0113	NA	NA	NA	1.74	NA
	Total	0.0477	4.80	NA	0.101	ND	10.1	12.0	18.0	9.86	3.14	NA	NA	NA	30.2	130
F1-2S (ZID BOUNDARY)	Dissolved	0.0190	1.56	NA	0.0610	NA	0.210	1.31	0.439	0.664	0.0192	NA	NA	NA	1.26	NA
	Total	0.183	4.93	NA	0.192	ND	28.9	35.9	64.9	29.0	10.4	NA	NA	NA	75.3	260
F1-3S (NEAR FIELD)	Dissolved	0.0159	1.54	NA	0.0581	NA	0.219	0.942	0.336	0.605	0.00904	NA	NA	NA	0.831	NA
	Total	0.158	2.88	NA	0.210	ND	32.7	41.8	76.2	32.8	12.2	NA	NA	NA	87.8	490
C1-1S (CONTROL)	Dissolved	0.0180	1.45	NA	0.0598	NA	0.358	0.878	0.778	0.631	0.0434	NA	NA	NA	0.950	NA
	Total	0.0792	6.52	NA	0.159	ND	21.6	25.9	42.9	20.8	7.39	NA	NA	NA	55.7	150
C1-2S (CONTROL)	Dissolved	0.0240	1.44	NA	0.0635	NA	0.547	1.11	0.954	0.891	0.0968	NA	NA	NA	1.16	NA
	Dissolved ^a	0.0201	1.50	NA	0.0596	NA	0.517	1.12	0.940	0.886	0.0924	NA	NA	NA	1.15	NA
	Total	0.274	11.36	NA	0.399	ND	76.0	94.0	182	74.8	28.2	NA	NA	NA	175	1100
	Total ^a	0.263	11.76	NA	0.390	ND	69.3	91.6	180	70.0	27.2	NA	NA	NA	163	1100
C1-3S (CONTROL)	Dissolved	0.0120 U	1.40	NA	0.0531	NA	0.244	0.712	0.370	0.611	0.00664	NA	NA	NA	0.425	NA
	Total	0.188	4.42	NA	0.279	ND	50.9	62.7	105	50.5	18.6	NA	NA	NA	123	750
EFFLUENT	Dissolved	1.39	3.17	0.014 U	0.216	NA	3.50	34.8	20.0	4.36	0.706	0.429	3.57	0.00381	43.4	NA
	Total	5.41	3.61	0.022 U	0.502	29	4.94	57.8	118	5.67	4.88	0.641	3.63	0.00617	88.2	750
DETECTION LIMIT	Dissolved	0.012	0.040	0.014	0.002	NA	0.059	0.005	0.17	0.006	0.003	0.002	0.729	0.001	0.004	NA
	Total	NA	0.012	0.022	0.005	2.0	0.053	0.004	NA	0.005	0.002	0.002	0.328	0.001	0.016	1.0

Analyte Abbreviations: Ag (silver), As (arsenic), Be (beryllium), Cd (cadmium), CN (cyanide), Cr (chromium), Cu (copper), Hg (mercury), Ni (nickel), Pb (lead), Sb (antimony), Se (selenium), Tl (thallium), Zn (zinc), TSS (total suspended solids)

^a Laboratory duplicate

NA Not applicable/available

ND None detected

U Not detected at or above detection limit

Table 17. Supplemental Receiving Water and Effluent Hydrocarbon Analyses.

Parameter	Control Flood Samples			ZID Flood Samples			Effluent
	C1-1S	C1-2S	C1-3S	F1-1S	F1-2S ^a	F1-3S	
Volatile Organics (EPA 602) in µg/L; detection limit for each analyte 0.5 µg/L							
Benzene	ND	ND	ND	ND	ND/ND	ND	0.54
Toluene	ND	ND	ND	ND	ND/ND	ND	8.6
Chlorobenzene	ND	ND	ND	ND	ND/ND	ND	ND
Ethylbenzene	ND	ND	ND	ND	ND/ND	ND	0.89
Xylenes	ND	ND	ND	ND	ND/ND	ND	8.2
1,2 Dichlorobenzene	ND	ND	ND	0.71	ND/ND	ND	15
1,3 Dichlorobenzene	ND	ND	ND	ND	ND/ND	ND	ND
1,4 Dichlorobenzene	ND	ND	ND	ND	ND/ND	ND	3.3
Total Aromatics (as BETX)	ND	ND	ND	ND	ND/ND	ND	18.23
Polynuclear Aromatic Hydrocarbons (PAH) by GC/MS in µg/L							
Total PAH ^b	ND (1.01)	ND (1.01)	ND (1.01)	ND (1.01)	ND (1.01)	ND (1.01)	ND (1.06)
Total Aqueous Hydrocarbons (TAqH) in µg/L							
TAqH ^{b,c}	ND (3.01)	ND (3.01)	ND (3.01)	ND (3.01)	ND (3.01)	ND (3.01)	19.29

^a Duplicate field sample analysis provided (value/duplicate value)

^b Detection limits are included in parentheses for non-detected values (ND)

^c Defined by the State of Alaska as BETX analyte values from EPA Method 602 plus PAH analyte values from EPA Method 610 analysis; method detection limit added for values reported as non-detect (ND)

ND None detected

Table 18. Summary of Bacterial Analyses, 16 August 2000.

Station and Replicate	Sample Time (ADT)	Fecal Coliform MPN/100 mL
IT-1 Replicate 1	20:48	7.0
IT-1 Replicate 2	20:48	30.0
IT-2 Replicate 1	20:43	4.0
IT-2 Replicate 2	20:43	2.0
IT-3 Replicate 1	20:39	2.0
IT-3 Replicate 2	20:39	4.0
IT-4 Replicate 1	20:35	8.0
IT-4 Replicate 2	20:35	4.0
IT-5 Replicate 1	20:30	2.0
IT-5 Replicate 2	20:30	17.0
IT-6 Replicate 1	20:25	8.0
IT-6 Replicate 2	20:25	13.0
IT-7 Replicate 1	20:20	13.0
IT-7 Replicate 2	20:20	4.0
IT-C4 Replicate 1	21:05	4.0
IT-C4 Replicate 2	21:05	23.0
Plant Effluent Rep. 1	16:10	500
Plant Effluent Rep. 2	16:10	500
Fish Creek Rep. 1	13:12	1600
Fish Creek Rep. 2	13:12	1600
Chester Creek Rep.1	13:02	30.0
Chester Creek Rep.2	13:02	110.0
Ship Creek Rep. 1	12:35	30.0
Ship Creek Rep. 2	12:35	4.0

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 OBJECTIVES

The program includes a comprehensive quality assurance/quality control (QA/QC) program that encompasses all aspects of the project, from initial sample collection and field observation recording through laboratory analysis and data analysis to reporting. The objectives of the QA/QC program were to fully document the field and laboratory data collected, to maintain and document data quality, and to ensure that the data collected are of sufficient quality to be comparable with data collected through other EPA-regulated NPDES programs. The program was designed to allow the data to be assessed by the following parameters:

- Precision
- Accuracy
- Comparability
- Representativeness
- Completeness.

These parameters were controlled by adhering to documented methods and procedures, by the analysis of quality control (QC) samples on a routine basis, through the use of laboratories with existing QA/QC plans, through data review and verification procedures, and through a comprehensive sample documentation program. Throughout the program, KLI coordinated with the subcontracting laboratories to ensure that their in-house QA/QC programs were being implemented to meet the required standards.

Quality control activities in the field included adherence to documented procedures, including those in this study plan, and the comprehensive documentation of sample collection and sample identification information. Sample integrity and identification were ensured by a rigidly-enforced chain of custody program. The chain of custody procedure documents the handling of each sample from the time the sample was collected to the arrival of the sample at the laboratory.

Analytical methods in use on the program have been approved and documented by EPA. These methods were used as project-specific protocols to document and guide analytical procedures. Adherence to these documented procedures ensure that analytical results are properly obtained and reported.

4.2 FIELD QUALITY CONTROL

Quality control activities in the field consisted of the following:

- adherence to documented procedures in the workplan
- cross-checking of field identifications, measurements, and recording to ensure consistency and accuracy
- comprehensive documentation of field observations, sample collection, and sample identification information.

Sampling procedures proposed for this project have been successfully used for a number of years on the Point Woronzof monitoring program. The use of documented and well-known procedures provides for greater likelihood of obtaining environmental samples uncontaminated by sampling procedures or apparatus. The use of project-specific field forms and data entry sheets also provide guidance for sampling procedures. Adherence to these procedures and use of these project documents helped ensure that data collected over the course of the project were comparable and accurate and that the study results are representative of conditions existing at the sampling sites.

4.2.1 Documentation

For observations made in the field, cross-checking between personnel were used as the primary method of quality control. These included, for example, review of navigational information recorded on the drogue field log. As described in the Methods section, sample documentation began in the field using pre-printed logs, labels, COC forms, and pre-determined sample identification numbers that were designed specifically for use on this project. This extensive field documentation provided a paper trail that exists for each sample or field observation and ensures credibility of the data. All field records were reviewed by the field crew leader as soon as possible after sampling was completed. Completed field logs were filed at the KLI Anchorage office upon return of the survey.

Sample integrity and identification were ensured by the COC program. The chain of custody procedure documented the handling of a sample from the time the sample was collected to the arrival of the sample at the laboratory. At the time of shipment, the field personnel kept a copy of the completed chain of custody form, and the original will accompany the samples to the laboratory.

4.2.2 Sample Handling

Samples were frozen, chilled, and/or preserved as required by the appropriate methods in the field and until receipt at the laboratory. Samples were packed in coolers along with the completed COC forms for shipment to analytical facilities as described in the Methods section. Coolers were securely packed with ice packs as required and sealed with signed and dated fiber tape for shipment.

4.2.3 Navigation

As described above, navigation was accomplished with a DGPS from a shore based differential beacon that was installed for the survey. The accuracy of the DGPS coordinates were verified by positioning the vessel over the diffuser during a low slack tide when the boil was evident and comparing DGPS readings with the known outfall location. In addition, the sampling vessel was equipped with a backup DGPS system based on the Coast Guard transmitting station in Kenai, which provided redundancy in the event that primary DGPS coordinates were erroneous or could not be obtained due to satellite downtime or equipment problems. Intertidal stations were re-occupied using a hand-held GPS, distance and bearings, and visual sitings to temporary benchmarks and landmarks. All station information was entered on the appropriate field logs and reviewed by the field leader.

4.2.4 Field Instrumentation

Field equipment used for collection, measurement, and testing were subject to a strict program of control, calibration, adjustment, and maintenance. Care was taken to ensure that the instruments used for field measurements of temperature, salinity, DO, and pH were calibrated and adjusted with appropriate standards prior to and after each sampling. The standards of calibration are in accordance with applicable criteria such as the U.S. Bureau of Standards, American Society of Testing and Materials (ASTM) Standards, and follow the instrumentation manufacturer's recommended procedures.

Temperature calibration was ensured by pre-calibration at the factory and field checks of the electronic temperature sensor against a research grade thermometer reading taken from the same sample at the same time. The electronic sensor for salinity (conductivity) was also pre-calibrated at the factory and field checked against six ambient water samples were collected for the analysis of salinity (SM 2520B) to verify the proper operation of the probe. For pH, the electronic sensor probe was pre-calibrated using three known buffer solutions. Dissolved oxygen samples were collected from the Niskin[®] bottles at surface, mid-, and bottom depths at every station to compare with the DO probe readings. Levels of DO in these samples were determined using the Winkler titration method (SM 4500-O C).

4.2.5 Sampling Variability

Sampling variability was documented by sampling three replicates at one station for the water quality parameters. This included three replicate Niskin[®] bottle casts to obtain replicate turbidity samples and three replicate grabs at the surface for fecal coliform, color, and TRC analyses. In addition, triplicate casts of the CTD for pH, DO, temperature, and salinity were performed at one station in order to check reading variability from the probe's electronic sensors.

4.2.6 Field Check Samples

Field check samples include trip blanks for volatile organic analyses for EPA Methods 602 and 624, field blanks, field generated duplicates, and SRMs, spikes or other samples of known concentration that may be sent to the laboratory. With the exception of the trip blanks which are initiated at the laboratory, these samples were sent to the laboratory as blind samples to ensure unbiased reporting of results.

4.3 LABORATORY QUALITY CONTROL

Analytical quality control for this project included the following:

- adherence to documented procedures, particularly EPA methods, internal laboratory protocols, and respective laboratory QA/QC programs
- calibration of analytical instruments
- ability of each analytical laboratory to meet analytical precision, accuracy, limits of detection, and limits of quantification that meet EPA requirements
- use of quality control samples, internal standards, and surrogate solutions

The analytical laboratories used on this project operate under the quality assurance (QA) programs described in their QA management plans. These programs involve the participation of qualified and trained personnel; the use of standard operating procedures for analytical methodology and procedures; a rigorous system of documenting and validating measurements; maintenance and calibration of instruments; and the analysis of quality control samples for precision and accuracy tracking. The pertinent methods descriptions the laboratories are following are comprehensive and provide information concerning proper sample collection, processing, storage, and preservation; required apparatus and materials; analytical procedure; standardization and calibration techniques; quality control samples required; methods of calculating values and assessing data quality; and reporting and performance criteria.

4.3.1 Documentation

Documentation in the laboratory included finalizing the original COC forms and generating the internal documents that track samples through the laboratory (e.g., sample control logs, refrigerator logs, etc). Any deviations from the prescribed methods or internal laboratory standard operating procedures (SOPs) were documented in the project files. Data affected by such deviations were appropriately qualified, as was any data that did not meet acceptable quality criteria. Typical data qualifiers included those denoting estimated concentrations (J) or not detected (ND or U).

4.3.2 Calibration

Calibration is an integral part of any instrumental analysis. Calibration requirements for each type of analysis to be used on this project are described in the appropriate methods. Typically, instrument calibration was performed daily or on a per batch basis.

4.3.3 Quality Control Procedures

Internal laboratory quality control checks included the use of surrogate solutions and quality control samples such as procedural (or method) blanks, matrix spike/spike duplicates, standard reference materials (SRMs) or EPA QC check samples, and duplicates as specified in the EPA approved analytical procedures. Surrogate compounds were spiked into samples as appropriate to measure individual sample matrix effects that are associated with sample preparation and analysis. This includes QC samples such as procedural blanks and matrix spike samples. Surrogate compound analyses were reported in percent recovery. Results from quality control samples allow the assessment of quality assurance parameters such as accuracy and precision of the data. Any data falling outside the acceptable criteria as defined in the methods were appropriately investigated and qualified.

Method blanks are pure, organic- or metal-free reagent water that are run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. Method blanks were analyzed as called for by each method, typically one per day or one per sample batch.

Laboratory accuracy was assessed by routine spiking of environmental samples with a standard addition as called for by the appropriate method. Sample spikes and matrix spike/matrix spike duplicates were run on the organic analyses collected as part of both the influent, effluent, and sludge

and receiving water monitoring components of the program. These samples are fortified with components of interest following the initial analysis to check the ability of the method to recover acceptable levels and to determine accuracy of the data. Quality control charts are prepared by the laboratories where applicable to show the range of individual measurements encountered by following procedures such as those outlined in *Design of 301(h) Monitoring Programs for Municipal Wastewater Discharges to Marine Waters*. EPA Document 430/9-82-010.

Trace metals analyses for the monitoring were supported through the use of standard reference materials (SRMs), which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards and other sources. These SRMs were analyzed by the laboratory at the same time as the program samples in order to ensure laboratory accuracy. Results of the analyses of SRMs should fall within acceptable limits and can be expressed as percent recovery.

Analytical and instrument variability was checked by laboratory splitting of one larger-volume field sample per survey into triplicates and analyzing the subsamples for the various water quality parameters. The individual measurements and concentration ranges were reported for each parameter of each split. In addition, duplicate analyses of samples split in the laboratory were used as a means to assess laboratory precision.

For other water quality parameters, the following summary of QA/QC procedures will apply:

- Fecal Coliform Bacteria: *Escherichia coli* was used as a positive control for each analytical run. *Pseudomonas aeruginosa* was used as a negative control, and buffered dilution water was used as a blank. In addition, ten percent of the samples were run in duplicate.
- Enterococci Bacteria: *Streptococcus faecalis* was used as a positive control for each analytical run. *Escherichia coli* was used as a negative control, and buffered dilution water was used as a blank.
- Color: Fresh color standards were made prior to the beginning of the program. Samples were allowed to settle and were pre-treated with paper filtration to remove turbidity and reported as “true color”. In addition, ten percent of the samples were run in duplicate.
- Turbidity: The instruments was calibrated with a 20.0 standard provided by the manufacturer. Due to the high turbidity in Cook Inlet, all samples were diluted to 10 % prior to analysis to ensure that the measured turbidities were within the range of the instrumentation. In addition, twenty percent of the samples were run in duplicate.
- Total Residual Chlorine: TRC was run by amperometric titration which requires a blank and laboratory control and laboratory control spike samples every ten samples. The amperometric titrant was standardized daily. Field analyses were performed immediately (within 5 minutes of collection) on board the survey vessel if at all possible.
- Salinity: A seawater salinity standard was used to check the instrumental accuracy of the salinometer every half-hour or every ten samples whichever is more frequent.

- Dissolved Oxygen Samples: The titrant used was standardized and checked on duplicate reference samples daily. The titrant strength was rechecked during the analyses.

4.3.4 Method Detection Limits

The method detection limits (MDLs) for the various analytes were determined using the appropriate method as described in 40 CFR 136, Appendix B. The MDL is defined as the lowest concentration of analyte that a method can reliably detect. The MDLs were determined by calculating results of seven replicate measurements of one low-level or spiked sample. The results of a Student's t-test at the 99 % confidence level were multiplied by the standard deviation of the seven replicates to obtain the lowest possible concentration that is quantifiable at this 99 % confidence limit (i.e., that is not considered an estimate). The MDL was adjusted for sample size for each individual sample for reporting purposes. Analyte concentrations falling below the calculated MDL but above zero (0) are considered estimates and were qualified. Concentrations equal to zero (0) are not measured and will typically be qualified with the "ND" code for non-detect.

4.4 DATA REVIEW AND VALIDATION

Data were verified by performing comparisons of final data against the original documentation, including this workplan, field logs and data sheets, and analytical reports. Any discrepancies were fully documented in the program files and reported in the annual report. Data were validated according to accuracy, precision, and completeness for both the field sample collection and analytical laboratory components of the program. Qualitative evaluation and statistical procedures were used to check the quality of the field and chemical data as appropriate. The primary goals of these review and validation procedures are to ensure that the data:

- are representative of conditions in the study area
- are accurate
- demonstrate the required level of precision
- are comparable with data from other NPDES programs
- are acceptable for use as a tool to evaluate permit compliance
- allow independent technical appraisal of the program's ability to meet the monitoring objectives.

Analytical data were subjected to review upon receipt from the laboratory following guidelines such as those published in *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, or *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, EPA 540/R-94/012. Items reviewed during data validation included sample holding times, results for laboratory method blanks, matrix spike/spike duplicates (MS/SD), check standards or SRMs, field and laboratory duplicates, field and trip blanks, report completeness, and laboratory performance (i.e., ability to achieve method detection limits and adherence to QA/QC criteria established for this program). Items failing to meet such validation and review procedures were noted and corrected, if possible. Items that could not be corrected and fell outside of acceptable limits (e.g., a sample analyzed outside holding time) were duly noted in the annual report.

4.5 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

4.5.1 Field Instrumentation and Sampling Quality Control Results

For influent, effluent, and sludge monitoring, field generated duplicate influent and/or effluent samples were collected for analysis of total aromatic hydrocarbons (EPA 602), total petroleum hydrocarbons, and pesticides during the June 2000 sampling. During the August 2000 sampling, duplicate effluent samples were collected for total aromatic hydrocarbons (EPA 602) and pesticides. Results for these duplicate analyses are provided in Tables 9 and 10 and the appendices, and were found to be within acceptance limits. Results from duplicate field samples collected for certain parameters during the receiving water sampling such as volatile organics (EPA Method 602), cyanide, and TSS are reported in the appropriate tables (Tables 16 and 17), and were found to be within acceptance limits.

Field blanks were collected for several parameters during each sampling event by pouring HPLC-grade deionized (DI) water into the appropriate sampling containers with the correct preservative. Trip blanks consisted of DI blank samples prepared at the laboratory that went through the same shipping and handling procedures as all the other sample containers of each analytical type; these remained unopened in the field. Field blanks and trip blanks analyzed using EPA Method 602 showed no measurable levels of the target compounds during the June 2000, August 2000, or receiving water monitoring (Appendices A2, B2, and D1). Field blanks analyzed in conjunction with the EPA 624 analyses for June 2000 and August 2000 showed no detectable levels of the target compounds (Appendices A3 and B3). However, the trip blank for EPA 624 during the August 2000 sampling showed concentrations of chloroform (17 µg/L), methylene chloride (10 µg/L), bromodichloromethane (3.4 µg/L), and 1,2-dichloroethane (1.6 µg/L). The source of this contaminant is unknown, however since none of these compounds was found in the associated field blanks or method blanks, introduction during sampling seems unlikely. The most likely source is laboratory contamination that was introduced when the trip blanks were made as methylene chloride is a common laboratory solvent and is often seen in laboratory quality control samples. Also, the building in which the laboratory, Severn Trent, was housed was undergoing renovation including the installation of new carpeting during this time period. The trip blank analyzed in conjunction with the EPA 624 analyses for June 2000 showed no detectable levels of the target compounds.

During the receiving water sampling, conductivity, temperature, and depth (CTD) profiles were obtained with a Seabird SEACAT SBE-19 recording oceanographic profiling system. This instrument also provided pH and DO measurements. Salinity and density were calculated from conductivity, temperature, and depth data. The CTD was equipped with a submersible pump to facilitate adequate flow across the sensors. Water samples and CTD profiles were taken simultaneously, with the former being analyzed in the laboratory except TRC, which was analyzed immediately onboard the sampling vessel. Sampling variability for water quality parameters (DO, fecal coliform bacteria, color, and turbidity) was determined by analyzing three surface samples taken at Station C2-2S (Table 19). Where appropriate, the mean, standard deviation, and coefficient of variation are included in Table 19 to provide a measure of variability for the listed parameters. The coefficient of variation the various sample types was found to be 1.8 % for DO, 25 % for color, and 1 % for turbidity. Sampling variability for fecal coliform was found to be within the 95 % confidence limits for all three samples.

Table 19. Sampling and Laboratory Variability for Water Quality Samples, 14 and 16 August 2000.

Station	Subsample Designation	DO (mg/L)	Fecal Coliform* (MPN/100 mL)	Color (units)	Turbidity (NTU)	TRC (mg/L)
SAMPLING VARIABILITY						
C2-2S	A	9.60	2.0[1-11]	15	180	NA
	B	9.34	<2.0[—]	10	178	NA
	C	9.66	2.0[1-11]	10	180	NA
Mean	---	9.53	---	12	179	---
Standard Deviation	---	0.17	---	3	1	---
Coefficient of Variation (%)	---	1.78	---	25	1	---
LABORATORY VARIABILITY						
C3-1S	A	9.37	2.0[1-11]	<5	340	<0.0089
	B	9.36	2.0[1-11]	<5	330	<0.0089
	C	9.32	2.0[1-11]	<5	330	<0.0089
Mean	---	9.35	---	<5	333	<0.0089
Standard Deviation	---	0.03	---	0	6	0
Coefficient of Variation (%)	---	0.28	---	0	2	0
C1-1S	A	NA	<2.0[—]	NA	NA	NA
	B	NA	<2.0[—]	NA	NA	NA
Relative % Difference	---	---	---	---	---	---
C2-3S	A	NA	NA	NA	330	NA
	B	NA	NA	NA	330	NA
Relative % Difference	---	---	---	---	0	---
C3-1M	A	NA	NA	NA	290	NA
	B	NA	NA	NA	300	NA
Relative % Difference	---	---	---	---	3	---
C3-3S	A	NA	NA	NA	310	NA
	B	NA	NA	NA	310	NA
Relative % Difference	---	---	---	---	0	---
C3-4B	A	NA	NA	NA	360	NA
	B	NA	NA	NA	360	NA
Relative % Difference	---	---	---	---	0	---
E1-1S	A	NA	4.0[1-17]	NA	NA	NA
	B	NA	4.0[1-17]	NA	NA	NA
Relative % Difference	---	---	---	---	---	---
E2-1S	A	NA	2.0[1-11]	<5	NA	NA
	B	NA	13.0[5-38]	<5	NA	NA
Relative % Difference	---	---	---	0	---	---
F1-1S	A	NA	130.0[50-390]	20	NA	NA
	B	NA	500.0[200-2000]	20	NA	NA
Relative % Difference	---	---	---	0	---	---
F1-2B	A	NA	NA	NA	300	NA
	B	NA	NA	NA	300	NA
Relative % Difference	---	---	---	---	0	---
F2-1S	A	NA	13.0[5-38]	NA	NA	NA
	B	NA	30.0[10-120]	NA	NA	NA
Relative % Difference	---	---	---	---	---	---
F3-1S	A	NA	4.0[1-17]	<5	NA	NA
	B	NA	4.0[1-17]	<5	NA	NA
Relative % Difference	---	---	---	0	---	---

* 95% confidence intervals indicated in brackets (American Public Health Association, 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. Washington, D.C. Table 9221.IV.)

NA Not analyzed

--- Not applicable

Variability and calibration checks of the electronics probe were done by performing repeated profiles of temperature, pH, and salinity at one station (C2-2). Results of these calibration checks for the Seabird probe show that probe variability for temperature, pH, and salinity was extremely low and in most cases with a coefficient of variation of <1 % (Table 20). In addition, salinity data obtained from the CTD were compared with six salinity grab samples that were collected during the receiving water monitoring survey. Hydrographic data from the CTD can be compared with grab sample results (Appendices D4 and D5). In addition, a precision thermometer was used to verify CTD temperature readings, *in-situ* DO readings from the CTD were compared with Winkler titration results, and the pH sensor was calibrated against three standards prior to field deployment. DO concentrations obtained from the CTD were found to be more variable and were felt to be less reliable than the values obtained by titration. Therefore, the Winkler titration results were utilized in this report. The temperature and pH probes were accurate and within calibration during the survey.

4.5.2 Laboratory Quality Control Results

Total and dissolved metals were analyzed in duplicate for several of the receiving water samples, as indicated in Table 16 and Appendix D2. Full analytical data are provided for each laboratory in the appendices. Laboratory duplicate analyses were found to have a high degree of precision and within the acceptance criteria of 20 % relative percent difference (RPD). Laboratory duplicates were also run for a number of organic analysis also, and found to be within acceptance limits.

In addition to the standard laboratory QC procedures, color, fecal coliform, turbidity, and TRC samples collected at Station C3-1 during the receiving water sampling were split in the laboratory and analyzed in triplicate. Mean, standard deviation, and coefficient of variation are reported in Table 19 for these samples (where appropriate). These statistics were not determined for fecal coliform due to nature of the analysis which yields only a most probable number of bacteria per 100 mL. Instead, the $\pm 95\%$ confidence limits for each sample are provided in Table 19. For other stations where samples were analyzed in duplicate, such as TRC, turbidity, and color samples, the relative percent difference between duplicates was calculated. Laboratory duplicate analyses were found to be in general very low and within acceptable limits. Duplicate results for turbidity ranged from 0 to 3 % RPD. Color duplicate results were within acceptable limits with 0 % difference between duplicates.

Laboratory accuracy was assessed through the use of surrogate recoveries, sample and control spikes and duplicates, and SRMs. Detailed QA/QC results for all contract laboratory analyses are provided in the appendices corresponding to each analyses. Surrogates are compounds that were added to each sample and QC sample that were analyzed by GC methodology, such as volatile organic compounds (EPA 602 and 624/8260), semivolatile organic compounds (EPA 625/8270), and pesticides (EPA 608/8081 and 614/8141A). Surrogate recoveries for all analyses were found to be within the QC recovery limits specified by the method.

Matrix spike (MS), matrix spike duplicates (MSD), laboratory control spike (LCS) and duplicate control spike (DSC) are samples and blanks that are spiked with target compounds of interest to determine percent recovery and relative percent difference between duplicates. The QC criteria include an acceptable recovery range and an RPD that should not be exceeded. Total metals, dissolved metals, cyanide, volatile organic compounds, and semivolatile organic met all QC criteria

Table 20. Seabird SEACAT SBE-19 CTD Probe Variability Check, 14 August 2000.

Depth (M)	Temperature (C)			Salinity (ppt)			pH			Mean (units)			Standard Deviation (units)			Coefficient Of Variation (%)		
	2A	2B	2C	2A	2B	2C	2A	2B	2C	Temp	Sal	pH	Temp	Sal	pH	Temp	Sal	pH
1.0	14.50	14.41	14.62	6.98	6.88	6.83	7.96	7.94	7.90	14.51	6.90	7.93	0.107	0.077	0.030	0.73	1.12	0.37
2.0	14.47	14.40	14.62	7.00	6.89	6.84	7.96	7.94	7.91	14.49	6.91	7.94	0.115	0.084	0.022	0.79	1.22	0.27
3.0	14.44	14.41	14.47	7.00	6.89	6.88	7.96	7.94	7.92	14.44	6.92	7.94	0.029	0.067	0.020	0.20	0.98	0.25
4.0	14.40	14.40	14.46	7.00	6.89	6.88	7.96	7.94	7.92	14.42	6.92	7.94	0.035	0.064	0.018	0.24	0.92	0.23
5.0	14.37	14.35	14.38	6.99	6.91	6.90	7.96	7.94	7.93	14.36	6.93	7.94	0.016	0.052	0.016	0.11	0.75	0.20
6.0	14.36	14.32	14.35	6.99	6.92	6.91	7.96	7.94	7.94	14.34	6.94	7.95	0.019	0.042	0.013	0.14	0.60	0.16
7.0	14.34	14.29	14.32	6.99	6.95	6.93	7.96	7.94	7.94	14.32	6.96	7.95	0.024	0.028	0.011	0.17	0.41	0.14
8.0	14.32	14.29	14.30	6.99	6.95	6.94	7.96	7.94	7.94	14.30	6.96	7.95	0.015	0.025	0.012	0.10	0.37	0.15
9.0	14.28	14.28	14.30	7.00	6.99	6.95	7.96	7.94	7.95	14.29	6.98	7.95	0.011	0.028	0.012	0.08	0.41	0.15
10.0	14.24	14.27	14.29	7.01	7.04	6.96	7.96	7.94	7.95	14.27	7.01	7.95	0.021	0.042	0.012	0.15	0.61	0.15
11.0	14.21	14.21	14.29	7.02	7.10	6.97	7.96	7.93	7.95	14.24	7.03	7.95	0.042	0.064	0.014	0.29	0.92	0.17
12.0	14.19	14.19	14.29	7.03	7.11	7.01	7.96	7.93	7.95	14.23	7.05	7.95	0.059	0.053	0.014	0.41	0.75	0.17
13.0	14.16	14.18	14.30	7.05	7.12	7.06	7.96	7.93	7.95	14.21	7.08	7.95	0.073	0.035	0.015	0.52	0.50	0.19
14.0	14.15	14.19	14.26	7.03	7.11	7.09	7.96	7.93	7.95	14.20	7.08	7.95	0.057	0.039	0.016	0.40	0.55	0.20
15.0	14.14	14.18	14.22	7.02	7.09	7.10	7.96	7.93	7.95	14.18	7.07	7.95	0.039	0.044	0.017	0.28	0.62	0.22
16.0	14.14	14.18	14.19	7.01	7.07	7.12	7.97	7.93	7.95	14.17	7.06	7.95	0.027	0.051	0.017	0.19	0.72	0.21
17.0	14.13	14.17	14.18	7.00	7.06	7.13	7.97	7.93	7.95	14.16	7.06	7.95	0.026	0.064	0.018	0.19	0.90	0.22
18.0	14.13	14.16	14.18	6.98	7.06	7.13	7.97	7.93	7.95	14.15	7.06	7.95	0.025	0.075	0.020	0.18	1.06	0.25

for MS, MSD, LCS, and DCS for all analyses on the program. With the exception of one compound on one analysis, pesticides also passed all QC spike criteria. For the August 2000 pesticide analysis, the LCS for methyl parathion had a recovery of 48 % compared to the acceptance limits of 50-150 %.

Trace metals analyses for the influent, effluent, sludge, and receiving water testing were supported through the use of Standard Reference Materials (SRMs), which are quality control reference materials with known metals values that are obtained from the National Bureau of Standards, National Institute of Standards and Technology, or other certified standards. These SRMs are analyzed by the laboratories at the same time as the project samples in order to ensure laboratory accuracy. Results of the analyses of SRM's should fall within acceptable limits and can be expressed as percent recovery. Except for dissolved nickel and cadmium in the seawater SRM for the receiving water program, all metals SRMs were within acceptance limits. Differences in these two metals were at extremely low levels of 0.08 µg/L (25 % RPD) for nickel and 0.0075 µg/L (29 % RPD) for cadmium compared to the laboratory's internal criteria of 20% RPD. These differences are at levels of two orders of magnitude less than the receiving water limit of 8.2 µg/L for nickel and three orders of magnitude less than the receiving water limit of 9.3 µg/L for cadmium. In addition, SRMs were also analyzed for TSS and cyanide receiving water samples and found to be within acceptance recovery limits (Appendix D1).

Method blanks (or procedural blanks) were also analyzed for most analyses on the program. Method blanks consist of pure, organic- or metal-free reagent water that is run through the analysis process and used to verify that analyte concentrations are accurate and do not reflect contamination. With the exception of ultra-trace level metals analyses that were conducted as part of the receiving water program, all method blanks results for the entire program showed no contamination during 2000. The method blank analyses for metals showed very small amounts of the various metals, most of which were present at levels below detection limits (Appendix D2). Lead in the total recoverable method blank and antimony in the dissolved method blank were found at levels higher than the instrument detection limits. This is typical for low-level analyses such as these and does not adversely affect data quality. The method blank analyses performed with the TSS and cyanide analyses showed no results above method detection limits. In addition to the typical method blanks, buffered dilution water was used as a blank for fecal coliform and enterococci bacteriological analyses. All blanks run for fecal coliform and enterococci showed no growth.

5.0 DISCUSSION

5.1 INFLUENT, EFFLUENT, AND SLUDGE MONITORING

The NPDES permit for the Point Woronzof treatment plant requires compliance with applicable State water quality standards as promulgated in Chapter 70 of the Alaska Administrative Code entitled "Water Quality Standards" (18 AAC 70; ADEC, 1999). This chapter requires that criteria outlined in "EPA Quality Criteria for Water" (also known as "The Red Book"; EPA, 1976), the revised quality criteria for water published in 1986, and other applicable criteria as referenced in the AWQS be met in applicable receiving waters at every point outside of the ZID boundary. Also, as noted in Section 1.1.1, the State of Alaska water quality regulations include SSWQC for the Point Woronzof area of Cook Inlet for turbidity and the dissolved fraction of arsenic, cadmium, hexavalent chromium, copper, lead, mercury, nickel, selenium, and silver. Finally, the permit itself includes some effluent limitations that must be met. The following sections discuss the parameters of concern in regards to the requirements of the NPDES permit or the AWQS as well as historical data from the WWTF, data from other publicly-owned treatment works (POTWs), or other EPA data.

5.1.1 Influent and Effluent Monitoring

Table 21 lists permit effluent limitations and water quality criteria that were are applicable to the 2000 NPDES permit; it includes each of the parameters required to be monitored by the permit. Most of the values shown are the chronic toxicity criteria for salt water aquatic life. Chronic toxicity criteria concentrations are lower than acute toxicity criteria concentrations; therefore, the most stringent of the two were used here for comparison. The MAEC for each constituent was calculated from the outfall design dilution factor of 143:1, the water quality criteria, and the natural background concentrations. It was assumed that the final effluent would be diluted by a minimum factor of 143 by the time it reached the boundary of the ZID. For most metals, the MAECs were calculated from the new SSWQC for dissolved metals contained in the AWQS for the Point Woronzof area.

To determine compliance with State water quality standards, Table 21 can be compared with effluent values found in Tables 8 through 11 as well as those in Tables 16 and 17. The AWWU 2000 maximum effluent concentrations shown in Table 21 were the maximum encountered during the calendar year either in AWWU's in-plant monitoring, during the toxic pollutant and pesticide monitoring events, during pretreatment monitoring, or during the receiving water sampling event. For metals, both total and dissolved concentrations in the effluent were compared against their MAEC, since it is assumed that all of the metals contained in the effluent are potentially bioavailable upon entering the receiving water. All effluent concentrations were found to be much lower than the MAECs from the permit or computed from the water quality standards provided for in the AWQS. In addition, all the permit limitations but one (for fecal coliform) were met for the 2000 program year. Individual parameters are discussed more fully below.

When the MAECs for metals and cyanide in Table 21 were compared to AWWU's self-monitoring data, the toxic pollutant and pesticides sampling events (June 2000 and August 2000), the pretreatment monitoring data, and the effluent data from the receiving water quality sampling event, no constituent exceeded their MAECs. The highest concentrations of either total or dissolved metals seen in 2000 were all well below their respective MAECs. The two metals that most closely approached their MAECs were copper and mercury, and both of these were still seen at levels that

Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2000 Maximum Concentrations for Effluent Comparisons. Non-compliant values are shown in **bold type**.

Parameter	Receiving Water Quality Standard ^a		Maximum Allowable Effluent Concentration ^b	AWWU 2000 Maximum Effluent Concentration ^c
	(µg/L)		(MAEC)(µg/L)	(µg/L)
Antimony	146	Human health, not listed for saltwater aquatic life	20,751	ND (10) ^d
Arsenic	36	Chronic toxicity, measured as dissolved	4,916	4 ^e
Beryllium	11	For the protection of aquatic life in soft fresh water	1,523	ND (0.1) ^{d,e}
Cadmium	9.3	Chronic toxicity, measured as dissolved	1,331	6 ^{d,e}
Chromium (VI) ⁱ	50	Chronic toxicity, measured as dissolved	7,087	10 ^{d,e}
Copper	3.1	Chronic toxicity, measured as dissolved	319	60 ^e
Lead	8.1	Chronic toxicity, measured as dissolved	1,148	27 ^e
Mercury	0.025	Chronic toxicity, measured as dissolved	2.73	0.2 ^e
Nickel	8.2	Chronic toxicity, measured as dissolved	985	50 ^e
Selenium	71	Chronic toxicity, measured as dissolved	10,207	ND (10) ^d
Silver	1.9	Acute toxicity, measured as dissolved	258	10.5 ^e
Thallium	2130	Acute toxicity to saltwater aquatic life	306,697	ND (10) ^d
Zinc	81	Chronic toxicity, measured as dissolved	11,328	100 ^e
Cyanide	2	For marine aquatic life	288	29 ^f
Total Aqueous Hydrocarbons (TAqH)	15	Growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers ^g	2,160	19.29 ^f
Total Aromatic Hydrocarbons as BETX	10	Same as above ^g	1,440	71.8 ^d

Table 21. NPDES Requirements, State of Alaska Water Quality Standards, and AWWU 2000 Maximum Concentrations for Effluent Comparisons. (continued) Non-compliant values are shown in **bold type**.

Parameter	Receiving Water Quality Standard ^a	Maximum Allowable Effluent Concentration ^b (MAEC)	AWWU 2000 Maximum Effluent Concentration ^c
pH	<i>h</i>	6.5 - 8.5 (pH units)	6.6 - 8.0 (pH units) ^e
Total Residual Chlorine	<i>h</i>	Daily Max. 1.2 mg/L	Daily Max. 0.9 mg/L ^e
BOD ₅	<i>h</i>	Monthly Avg. 240 mg/L Weekly Avg. 250 mg/L Daily Max. 300 mg/L Removal Rate >30 %	Monthly Avg. 144 mg/L ^e Weekly Avg. 161 mg/L ^e Daily Max. 173 mg/L ^e Monthly Rate 41-50% ^e
Total Suspended Solids	<i>h</i>	Monthly Avg. 170 mg/L Weekly Avg. 180 mg/L Daily Max. 190 mg/L Removal Rate >30%	Monthly Avg. 52 mg/L ^e Weekly Avg. 60 mg/L ^e Daily Max. 94 mg/L ^e Monthly Rate 79-85% ^e
Fecal Coliform	<i>h</i>	Monthly geometric mean of at least five samples shall not exceed 850. Not more than 10% of samples shall exceed 2600 FC MPN/100 mL.	Monthly Geometric Mean did not exceed 252. The criterion of not more than 10% of samples exceeding 2600 FC MPN/100 mL was not met this year during the months of July (15%) and October (29%). ^e

a Alaska Administrative Code, 1999. Water Quality Standards, Chapter 70 (18 AAC 70)

b Effluent water quality criteria were determined by assuming a dilution of 143:1 at the ZID boundary, where: MAEC = 143 * (Criteria - Natural Background Concentration) + Criteria; pollutant concentrations in the effluent should not exceed these values.

c For metals, the maximum effluent concentration was determined from both total and dissolved concentrations.

d Values from June 2000 or August 2000 toxic pollutant and pesticide samplings.

e Values from MOA's monthly monitoring or pretreatment program

f Values from effluent tested during receiving water sampling event

g Alaska Administrative Code, 1999. Water Quality Standards, Chapter 70 (18 AAC 70)

h MAECs are not based on water quality criteria but instead are specified in MOA's 2000 NPDES permit

i All samples tested as total chromium

MGD Million gallons/day

were at an order of magnitude below their MAECs. The maximum concentration of total copper was 60 µg/L (during the monthly monitoring) compared to an MAEC of 319 µg/L. The highest dissolved copper concentration that was seen was 39 µg/L. The maximum concentration of total mercury seen was 0.2 µg/L (during the pretreatment monitoring) and highest dissolved mercury was 0.1 µg/L compared to an MAEC of 2.73 µg/L.

Those metals without SSWQC, while analyzed as both total and dissolved metals as called for by the permit, are compared to total metals MAECs as provided by EPA criteria and as called for by the AWQS. Total metals concentrations for antimony, beryllium, and thallium were generally low, often below detection limits, and all well below their MAECs. As in past years, total metals detected in the influent and final effluent of the Point Woronzof plant were compared with data from an EPA study of 40 Publicly Owned Treatment Works (POTWs) in Table 22 (EPA, 1982). Without exception, metals and cyanide values are lower than or within the range of those detected in other POTWs from across the nation, even though the Point Woronzof Plant provides only primary treatment as compared to secondary treatment provided at the other plants.

Historic influent and effluent total metals and cyanide concentrations collected as part of AWWU's self-monitoring program are presented in Tables 23 and 24. It should be noted that under the previous permit, the reporting year was November-October, which differs from the 2000 permit's reporting period of the calendar year. With few exceptions, concentrations are fairly consistent over time. Concentrations of total metals and cyanide concentrations seen in the influent and effluent during 2000 were found to fall within the range of concentrations seen during prior years. Dissolved metals have only been analyzed in a single sample of effluent in each of the past years (during the receiving water sampling) and historical data have not been presented in this report. Subsequent reports will include historical dissolved metal data as more become available.

During previous years, total copper levels would sometimes exceed the previous MAEC of 100 µg/L. While this permit limit is no longer in effect, it is interesting to note that the maximum total copper concentration encountered in the effluent during the year 2000 in-plant monitoring was 60 µg/L. The reasons for the elevated copper concentrations in previous years were investigated and reported to the Municipality by CH2M Hill and the AWWU laboratory. The conclusion of the copper investigation was that most of the copper in the influent is from the leaching of copper from residential plumbing rather than industrial discharge (CH2M Hill, 1987; CH2M Hill et al., 1988). Neither enforcement of the sewer ordinance (AMC 26.50) nor the industrial pretreatment program was expected to significantly reduce the amounts of copper received at the Point Woronzof facility. The mass of copper in the plant influent and effluent remained fairly constant from 1986 through 1991. From 1991 to 1992, the in-plant copper loading dropped by approximately twenty-five percent. The exact cause of this decrease is unknown, however, an increase in pH (to 8.0) at the Water Treatment Facilities (Ship Creek and Eklutna) during the Spring of 1991 caused a decrease in copper concentrations taken from "first draw" residential water sources in Anchorage. This increase in alkalinity was implemented to reduce corrosion in the drinking water distribution system. It would follow that these decreased values in drinking water would also affect the influent concentrations.

Total arsenic concentrations in the final effluent had remained fairly steady over the last five years, and 2000 was no exception. The highest monthly maximum for total arsenic for the final effluent during the reporting period was 4 µg/L, compared to an MAEC of 4,916 µg/L (Table 21).

Table 22. Comparison Between Influent/Effluent Analysis Results for Anchorage and 40 POTWs.^a Values in brackets indicate results from EPA Method 602.

Parameter	Anchorage Values				40 POTW Study Values				
	2000 Concentration ^{b,c} (µg/L)				Frequency of Detection (%)		Range Detected (µg/L)		Influent Median
	Summer-Dry		Summer-Wet		Influent	Secondary Effluent	Influent	Secondary Effluent	(µg/L)
	INF	EFL	INF	EFL					
VOLATILES									
Toluene	15[8.1/8.5]	10[7.0/6.8]	13[11]	27[23/23]	96	53	1-13000	1-1100	27
Ethylbenzene	1.4[ND/ND]	1.0[ND/ND]	2.7[9.8]	4.1[6.5/6.3]	80	24	1-730	1-49	8
Total Xylenes	NT[ND/ND]	NT[10/6.3]	NT[42]	NT[37/37]	NA	NA	NA	NA	NA
Benzene	ND[ND/ND]	ND[ND/ND]	ND[1.1]	4.3[5.3/5.3]	61	23	1-1560	1-72	2
Chloroform	2.9	3.8	2.6	3.3	91	82	1-430	1-87	7
Tetrachloroethene	1.5	1.3	1.4	1.4	95	79	1-5700	1-1200	23
Methylene chloride	5.8	3.8	1.1	1.8	92	86	1-49000	1-62000	38
1,2-Dichlorobenzene	ND[3.1/3.2]	ND[ND/11]	ND[3.4]	ND[9.5/8.0]	23	8	1-440	1-27	NA
1,3-Dichlorobenzene	2.6[4.0/3.6]	1.8[[10/11]	ND[ND]	ND[ND/ND]	7	2	2-270	5-5	NA
1,4-Dichlorobenzene	1.1[15/15]	ND[15/24]	ND[1.3]	ND[7.1/6.3]	17	3	2-200	3-9	NA
Trichloroethene	ND	ND	1.1	ND	90	45	1-1800	1-230	28
1,1,2,2-Tetrachloroethane	1.6	ND	ND	ND	7	3	1-52	1-5	NA
SEMI-VOLATILES ^d									
bis(2-Ethylhexyl)phthalate	ND	ND	16	10	92	84	2-670	1-370	27
Phenol	38	ND	ND	ND	79	29	1-1400	1-89	7
TOTAL METALS & OTHER COMPONENTS									
Antimony	ND	ND	ND/ND	ND	14	13	1-192	1-69	NA
Arsenic	ND	ND	3	3	15	12	2-80	1-72	NA
Beryllium	ND	ND	ND	ND	3	1	1-4	1-12	NA
Cadmium	ND	ND	ND	ND	56	28	1-1800	2-82	3
Chromium	ND	ND	10	10	95	85	8-2380	2-759	105
Copper	75	54	84	53	100	91	7-2300	3-255	132
Lead	6.4	4.8	15	8	62	21	16-2540	20-217	53
Mercury	0.2	0.1	0.3	ND	70	31	0.2-4	0.2-1.2	0.517
Nickel	ND	ND	ND	ND	79	75	5-5970	7-679	54
Selenium	ND	ND	ND/ND	ND	9	10	1-10	1-150	NA
Silver	6.3	5.3	9.3	5.3	71	25	2-320	1-30	8
Thallium	ND	ND	ND/ND	ND	3	2	1-19	1-2	NA
Zinc	150	77	130	80	100	94	22-9250	18-3150	273
Cyanide	ND	10	ND	10.8	100	97	3-7580	2-2140	249
PESTICIDES ^d									
4,4'-DDD	ND	ND	0.022	ND	<1	1	1.2-1.2	0.06-0.3	NA

^a Source: EPA, 1982. *Fate of Priority Pollutants in POTWs*. Final Report, Volume I, Effluent Guidelines Division, WH-552, EPA 440/1-82/303

^b Data from NPDES 2000 toxic pollutant and pesticide monitoring

^c Duplicate analyses provided for some analyses (value/duplicate value)

^d Only analytes detected above the detection limit in either the influent or effluent are included

NA Not available

ND Not detected

NT Not tested

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. Values in brackets are from EPA Method 602.

Pollutant	1995		1996		1997	
	Dry ^c	Wet ^{c,d}	Wet ^c	Dry ^c	Dry ^c	Wet ^c
	6/13	8/8	8/6-7	8/16-17	6/30-7/1	8/19-20
ORGANICS (µg/L)						
Phenol	22/14	ND	17.7	8.9/6.9	ND	ND
Diethyl phthalate	ND	ND	4.22	3.8/3.3	5.54	ND
Naphthalene	ND	ND	ND	ND	NT	NT
Benzene	ND[ND]	2.6[1.3/1.0]	0.39[0.5/0.6]	0.47[1.0/0.9]	1.26[0.96/0.86]	ND[0.81/0.82]
1,1,1-Trichloroethane	ND	ND	ND	ND	7.92	ND
Bromodichloromethane	ND	ND	0.20	0.24	ND	ND
Chloroform	3.2	3.7	3.7	3.0	3.39	2.98
Ethylbenzene	2.0[ND]	3.0[0.5/0.5]	1.29[0.6/0.6]	0.84[1.0/1.1]	1.23[0.7/0.86]	ND[ND/ND]
Methylene Chloride	15	3	7.84	4.13	ND	6.75
Tetrachloroethene	ND	ND	0.59	1.45	1.19	1.42
Toluene	13[6.1]	18[6.2/6.2]	13.8[11/11]	10.5[11/10]	14.4[9.3/9.1]	9.09[9.4/9.5]
Trichloroethene	ND	ND	0.24	0.25	ND	ND
* Acetone	140	85	87 ^e	106 ^e	ND	ND
* 4-Methyl-2-Pentanone	ND	ND	NT	NT	ND	ND
* Total Xylenes	12[2.0]	20.6[3.5/3.3]	8.71[2.3/2.4]	6.09[3.8/4.9]	7.66[5.4/5.3]	3.60[3.3/3.2]
Bis-(2-ethylhexyl)phthalate	ND	ND	ND	ND	13.3	ND
Di-n-octyl phthalate	ND	ND	ND	ND	ND	ND
* Benzyl Alcohol	ND	ND	15.0	12.3/9.8	8.97	ND
* 4-Methylphenol	60/ND	ND	56.7	58/49	44.0	ND
Acenaphthene	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	ND	ND	ND	ND/ND	ND	ND
Butyl benzyl phthalate	ND	ND	ND	ND	ND	ND
* 1,2-Dichlorobenzene	ND[ND]	ND[ND]	ND[ND]	ND[ND]	ND	ND
* 1,3- & 1,4-Dichlorobenzene	ND[2.1]	ND[8.7/8.7]	2.15[ND/ND]	1.5[ND]	1.12[1.6/1.5]	1.29
* Benzoic Acid	200/ND	150	181	201/157	ND	ND
* 2-Methylphenol	ND	ND	ND	ND	ND	ND
* 2-Butanone	46	31	NT	NT	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND
Total Hydrocarbons as Oil and Grease ^a	8400/3600	8700	ND	10000/ND	26100	25300
Total Petroleum Hydrocarbons ^b	840/720	800	ND	ND/ND	1630	1820/2090
Total Aromatic Hydrocarbons as BETX	27.0 [8.1]	44.2 [11.5/11.0]	24.2 [14.4/14.5]	17.9 [16.8/16.9]	24 [16.5/16.1]	14.7[14/14]

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	1998		1999		2000	
	Dry ^{c,d} 6/18-19	Wet ^c 8/11-12	Dry ^c 6/8-9	Wet ^c 8/24-25	Dry ^c 6/6-7	Dry ^c 8/14-15
ORGANICS (µg/L)						
Phenol	ND(9.9)	12	ND	ND/49 ^f	ND	ND
Diethylphthalate	1.7J	ND	8.0 J	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND
Benzene	ND[0.7/0.7]	ND[1.3/1.3]	ND[0.58/0.57]	3.0[ND/ND]	ND[ND/ND]	4.3[5.3/5.3]
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND
Chloroform	2.92	3.3	2.8	5.4	3.8	3.3
Ethylbenzene	0.06[0.5/0.5]	ND[1.5/1.5]	1.6[4.2/4.2]	2.6[ND/ND]	1.0[ND/ND]	4.1[6.5/6.3]
Methylene Chloride	3.35	7.2	6.8	5.7	3.8	1.8
Tetrachloroethene	1.50	3.2	1.6	1.4	1.3	1.4
Toluene	8.6[6.4/6.3]	9.5[8.0/8.0]	12	32[8.5/8.4]	10[7.0/6.8]	27[23/23]
Trichloroethene	ND	ND	ND	ND	ND	ND
* Acetone	ND	ND	NT	NT	NT	NT
* 4-Methyl-2-Pentanone	ND	ND	NT	NT	NT	NT
* Total Xylenes	ND[2.6/2.6]	ND[9.8/9.9]	NT[28/28]	NT[2.6/2.4]	NT[10/6.3]	NT[37/37]
Bis-(2-ethylhexyl)phthalate	9.6 J	15	11 J	21 B/ND ^f	ND	10
Di-n-octyl phthalate	1.7 J	ND	ND	ND	ND	ND
* Benzyl Alcohol	ND	ND	NT	NT	NT	NT
* 4-Methylphenol	NT	NT	NT	NT	NT	NT
Acenaphthene	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	1.3 J	ND	ND	ND	ND	ND
Butyl benzyl phthalate	1.4 J	ND	3.6 J	ND	ND	ND
* 1,2-Dichlorobenzene	ND[1.3/1.4]	ND[1.9/0.7]	ND[17/ND]	ND[ND/2.9]	ND[ND/11]	ND[9.5/8.0]
* 1,3- & 1,4-Dichlorobenzene	1.17[4.3/4.2]	ND[8.8/9.9]	2.2[6.8/7.1]	1.6[4.4/4.3]	2.8[25/35]	ND[7.6/6.8]
* Benzoic Acid	ND	ND	NT	NT	NT	NT
* 2-Methylphenol	ND	ND	NT	NT	NT	NT
* 2-Butanone	ND	ND	NT	NT	NT	NT
2,4-Dimethylphenol	ND	ND	ND	ND	NT	NT
Total Hydrocarbons as Oil and Grease ^a	25000/25000	30000	7800/7200	11000	21200	20300
Total Petroleum Hydrocarbons ^b	1820/2090	2600	ND/ND	ND	ND/ND	ND
Total Aromatic Hydrocarbons as BETX	[10.21/10.11]	[20.6/20.7]	[50.8/49.8]	[12.1/11.8]	[18/14.1]	[71.8/71.6]

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	1995		1996		1997	
	Dry ^c 6/13	Wet ^{c,d} 8/8	Wet ^c 8/6-7	Dry ^c 8/16-17	Dry ^c 6/30-7/1	Wet ^c 8/19-20
TOTAL METALS (µg/L)						
Antimony	0.6/0.6	<0.5	<10	<10/<10	ND	ND/ND
Arsenic	3	2	4	3	2	3
Beryllium	<0.1	<0.1	<0.1	<0.1	ND	ND
Cadmium	<5	<5	<4	4	ND	ND
Chromium	6	8	5	8	ND	ND
Copper	61	47	67	47	56	53
Lead	10	12	5	5	12	19
Mercury	<0.3	<0.3	<0.3	<0.3	ND	ND
Molybdenum	2.1/2.1	<5	2.6	ND/ND	ND	ND/ND
Nickel	<20	20	20	20	ND	30
Selenium	<2	<1	<2, <10 ^h	<2, <10/<10 ^h	ND, ND ^h	ND, ND/ND ^h
Silver	10.6	7.9	8.6	8.2	8.8	8.2
Thallium	0.6/0.6	<0.5	<10	<10/<10	ND	ND/ND
Zinc	79	75	77	74	40	73
PESTICIDES (µg/L)						
alpha-BHC	ND	ND	ND	ND	ND	ND
gamma-BHC (lindane)	ND	ND	0.94/ND	0.12	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND
Malathion	ND	ND	ND	ND	ND	ND
Parathion	ND	ND	ND	ND	ND	ND
OTHER						
Cyanide (µg/L)	40	20	30	20	20	20
Asbestos (million	1.500	4.900	ND	ND	ND	ND

Table 23. Comparison of Toxic Pollutants and Pesticides in Anchorage's Final Effluent to the Previous Five Years. (continued) Values in brackets are from EPA Method 602.

Pollutant	1998		1999		2000	
	Dry ^d 6/18-19	Wet 8/11-12	Dry 6/8-9	Wet 8/24-25	Dry ^c 6/6-7	Dry ^c 8/14-15
TOTAL METALS (µg/L)						
Antimony	ND	ND	ND	ND	ND	ND
Arsenic	3	13	3	3	ND	3
Beryllium	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	15	ND	ND
Chromium	ND	ND	ND	ND	ND	10
Copper	60	49	70	50	54	53
Lead	3	8	5	3	4.8	8
Mercury	0.1	ND	0.2	ND	0.1	ND
Molybdenum	ND	ND	ND	ND	ND	NT
Nickel	10	40	20	ND	ND	ND
Selenium	ND	ND	NT	ND	ND	ND
Silver	5.7	11.3	8.9	8.4	5.3	5.3
Thallium	ND	ND	ND	ND	ND	ND
Zinc	65	79	78	95	77	80
PESTICIDES (µg/L)						
alpha-BHC	ND	ND	ND	0.067	ND	ND
gamma-BHC (lindane)	ND	ND	ND	ND	ND/ND/ND	ND
4,4'-DDT	ND	ND	ND	ND	ND/ND/ND	ND/ND
Endosulfan Sulfate	ND	ND	ND	ND	ND/ND/ND	ND/ND
Endosulfan II	ND	ND	ND	ND	ND/ND/ND	ND/ND
Malathion	ND	ND	0.13	6.7	ND/ND/ND	ND/ND
Parathion	ND	ND	ND	0.56	ND/ND/ND	ND/ND
OTHER						
Cyanide (µg/L)	ND	ND	ND	ND	10	10.8
Asbestos (million)	ND	ND	ND	ND	ND	46

* Non-priority pollutants

a Analyzed using method SM 503B (1986-1995; 1997; 1998); method EPA 1664 HEM (1996; 1998; 1999; 2000)

b Analyzed using method SM 503E (1986-1995; 1997; 1998); method EPA 1664 SGT-HEM (1996; 1998; 1999; 2000)

c Duplicate effluent collected (filed duplicate) or analyzed (lab duplicate) shown as value/duplicate value

d Values from EPA Method 624 are the result of averaging eight samples with zero used for ND (1995 Wet; 1998 Dry)

e Acetone was classified as a Tentatively Identified Compound in 1996

f First EPA 625 sample run showed contamination in method blank; second run (outside holding time) also reported (1999 Wet)

g Conversion from ppm to millions of fibers per liter dependent on fiber size

h Selenium tested by two laboratories shown as AWWU value, ToxScan value (1996; 1997)

B Compound also detected in method blank

J Below method detection limit

ND Not detected

NT Not tested

Table 24. Historical Discharge Monitoring Data (1986 - Present) for Influent and Effluent Total Metals and Cyanide. Concentrations are in µg/L. Values represent average (Avg) or monthly minimum (Min) and maximum (Max) for 1995-1999 (program years running Nov. -Oct.) or a range of the results for years 1986-1994 as available. Results for 2000 include Avg., Min. or Max. of seven monthly values (Jan. - July) and pretreatment monitoring values (average of three results in August 2000).

Year	Flow (MGD)	Arsenic		Beryllium		Cadmium		Copper		Lead		Mercury		Nickel		Silver		Zinc		Chromium		Cyanide	
		Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
1986-1994 Min	23	<1	<1	NT	NT	<0.5	<0.5	36	38	<1	<1	<0.2	<0.2	<1	<1	3	1	54	41	<1	<1	<0.4	1
1986-1994 Max	39	26	16	NT	NT	20	30	280	150	68	50	3.0	1.5	60	60	30	98	260	240	50	120	85	47
1995 Avg	30	4	3	<0.1	<0.1	<5	<5	84	49	25	9	0.3	<0.3	<20	<20	10.4	6.6	145	70	6	14	<10	26
1995 Min	27	<1	<1	<0.1	<0.1	<5	<5	60	39	3	<1	<0.3	<0.3	<20	<20	1.8	2.0	93	58	<5	<5	<10	20
1995 Max	36	7	7	0.1	<0.1	5	8	105	64	76	43	0.7	0.4	50	40	17.2	12.6	183	87	11	52	<10	40
1996 Avg	30	3	2	<0.1	<0.1	5	4	91	51	12	7	0.4	<0.3	21	22	10.2	6.6	153	69	19	24	10	29
1996 Min	28	<1	<1	<0.1	<0.1	<4	<4	78	41	<1	<1	<0.3	<0.3	<20	<20	4.1	3.1	124	56	<4	10	<10	20
1996 Max	33	7	5	0.1	0.1	8	7	114	63	21	17	0.7	<0.3	30	30	17.0	12.4	201	80	112	98	10	50
1997 Avg	34	3	2	<0.1	<0.1	5	5	93	50	20	7	0.4	<0.2	24	23	9.4	6.4	140	64	7	12	<10	21
1997 Min	29	1	<1	<0.1	<0.1	<4	<4	63	10	10	4	<0.2	<0.2	<20	<20	3.4	2.2	91	38	<4	<5	<10	<10
1997 Max	40	5	4	0.3	0.2	7	5	123	64	59	11	0.8	0.2	40	40	17.5	10.0	186	97	13	23	<10	40
1998 Avg	29	4	3	0.1	0.1	5	5	74	41	12	6	0.3	0.2	26	22	11.1	6.8	136	64	8	10	15	15
1998 Min	27	<2	<2	<0.1	<0.1	<5	<5	60	30	4	<1	<0.2	<0.1	<20	<20	4.4	3.0	104	53	<5	<5	<10	<10
1998 Max	31	13	15	0.1	0.1	6	6	90	60	26	21	0.5	<0.2	77	40	16.1	11.1	182	88	10	16	<40	20
1999 Avg	29	4	3	0.2	0.2	6	6	91	57	22	7	0.5	0.2	28	22	7.1	4.9	142	77	11	12	<10	13
1999 Min	27	2	2	<0.1	<0.1	<5	<5	78	40	8	2	<0.1	<0.1	<20	<20	3.8	1.5	103	45	<10	<10	<10	<10
1999 Max	33	6	6	0.4	<0.4	17	10	120	70	149	15	1.5	0.4	50	40	12.6	7.9	197	114	20	20	<10	30
2000 Avg	29	6	3	<0.1	<0.1	<5	<5	84	46	11	8	0.3	<0.1	20	20	13.0	6.0	130	70	<10	<10	<10	<10
2000 Min	27	3	<3	<0.1	<0.1	<5	<5	60	30	6	<1	<0.1	<0.1	<20	<20	2.1	2.4	80	50	<10	<10	<10	<10
2000 Max	34	19	4	<0.1	<0.1	9	10	129	60	24	27	0.6	0.2	40	50	30.4	10.5	170	100	10	10	<10	10

Inf. Influent
Eff. Effluent
NT Not tested

Arsenic values are not a serious concern for this permit in terms of effluent concentrations, since the concentration in the final effluent is so much lower than the MAEC. Although proposed arsenic criteria for the 2000 NPDES permit are substantially lower than those utilized in the old permit, arsenic in plant effluent will likely remain well below the MAEC.

In a number of the past years, maximum concentrations of cyanide were near the prior MAEC of 50 µg/L but never approached the new MAEC (based on the new dilution factor of 143:1) of 288 µg/L. During 2000, the highest value encountered in the effluent was seen during the receiving water sampling event at 29 µg/L, well below the MAEC of 286 g/L. The concentration of cyanide in the effluent were measured at 10 and 10.8 µg/L during the June 2000 and August 2000 samplings, respectively. Monthly values taken in the first part of the year under the old permit ranged from <10 to 10 µg/L. Cyanide had been a constituent of concern in past years because it approached or even exceeded the prior MAEC in some years. It was observed (in 1986) that the effluent cyanide concentrations often exceeded the influent concentrations by an order of magnitude. This trend continued during subsequent years of sampling and was the subject of a special investigation conducted by the AWWU. The conclusion of this investigation was that the measured increase in cyanide between the influent and effluent was the result of the treatment plant's incinerator. Cyanide formed in the incinerator during sludge incineration is returned to the plant during the stack scrubbing process (CH2M Hill, 1987; CH2M Hill in association with Loren Leman, P.E., 1988). Subsequently, cyanide decreased and this was believed to be due to the change in the scrubbing water source from recirculated primary effluent to well water.

The most restrictive criteria of growth and propagation of fish, shellfish, other aquatic life, and wildlife was used for the hydrocarbon limits presented in Table 21. The MAECs for TAqH and total aromatic hydrocarbons as BETX were met this year, with maximum levels in the effluent well below the state-specified limits. The parameter of TAqH was analyzed in effluent only during the receiving water quality sampling, and the TAqH concentration was 19.29 µg/L as compared to the MAEC of 2,160 µg/L. The maximum BETX value of 71.8 µg/L was seen during the toxic pollutant and pesticide August 2000 sampling, and this value also fell well below the MAEC of 1,440 µg/L. The effluent sample collected in conjunction with the receiving water quality sampling event had a BETX concentration of 18.23 µg/L.

In addition to the MAECs based on the State and Federal water quality criteria, a number of other effluent limitations are specified in the NPDES permit. These daily, weekly, and monthly limitations include pH, TRC, BOD₅, TSS, and fecal coliform (Table 21). All of these parameters except fecal coliform were found to be within their 2000 permit limitations for the entire reporting period. For fecal coliform, the criterion of not more than 10 percent of the samples analyzed should exceed 2600 MPN/100 mL was not met in the months of July and October 2000, with 15 and 29 percent of the samples >2600 MPN/100 mL, respectively. The 2000 permit limitation of a monthly geometric mean (of at least five samples) that shall not exceed 850 MPN/100 mL was not exceeded during the report period, with the maximum geometric mean never exceeding 252 MPN/100 mL. These limitations were in the original 1985 permit and remained unchanged in the 2000 permit.

The permit limitations for monthly and weekly averages and daily maxima were met for both BOD₅ and TSS. In addition, removal rates of at least 30 % were met for these two parameters. Under the amendments to the Clean Water Act (40 CFR; Final Rule, 8/9/94), dischargers with 301(h) waivers are required to remove 30% of the BOD₅ and 30% of the suspended solids. When the Point

Woronzof discharge permit is renewed, these BOD₅ and TSS removal rates were put into effect, and the plant has already performing at well above these levels. Removal of BOD₅ averaged 44% for the 2000 calendar year. The average removal for TSS for this year was 82%, about the same reported for the last six years and well above the newly-implemented requirement of 30%.

Increased removal of BOD₅ and TSS shown over the last few years is due to a number of factors. The influent autosampler in use prior to January 1991 was found to be collecting non-representative samples. Comparison of results for samples collected from the permanently installed autosampler and a portable sampler indicated that the existing autosampler was collecting samples lower in BOD₅ and suspended solids. A new permanent autosampler was installed at the headworks to correct this problem in mid-1991. The primary reason that the new autosampler is more effective in collecting representative samples is that it provides higher line velocity and shorter transit time than the obsolete system, leading to less settling of solids during sampling. In addition, operational changes have been made which may affect percent removal rates for both BOD₅ and TSS, including changes in thickener loading and dewatering procedures, sample line cleaning, and a general increase in the number of clarifiers in use.

Concentrations of other toxic pollutants and pesticides detected in the influent and final effluent were lower than or within the range of those detected in other POTWs from across the nation, even though the Point Woronzof Plant provides only primary treatment as compared to secondary treatment provided at the other plants (Table 22). They also generally fell within the historical range of values seen in past years; levels of toxic pollutants and pesticides detected in the Anchorage effluent this year and over the previous five years are shown in Table 23. These data indicate some variability over time, but a generally similar pattern overall. Levels are low and often below reporting limits. As in the past, the types and concentrations of measured organic compounds varied between the two sampling periods. This is probably the result of different point sources discharging into the Municipality's wastewater system at various times. Also, in some instances, large differences in pollutant concentrations occurred between the influent and effluent. Inconsistencies can be explained by looking at sampling methodology and plant operation in the case of point-source contaminants. If spikes of contaminants are occurring in the influent, these might be hit or missed during sampling. On the other hand, an effluent sample could contain the contaminant because of mixing in the clarifiers. Differences in concentrations in influent and effluent samples could also be due to lower suspended sediment and particulate in the effluent samples. This can be seen in Table 8, where greater variability usually occurs in the influent concentrations as compared to the effluent.

Historic discharge monitoring data (1989 - 2000) for other parameters of concern measured in the influent and effluent are presented in Table 25. Most parameters have remained fairly steady over time. Dissolved oxygen levels had been steadily increasing since 1986 but showed a peak in 1992, with generally decreasing levels over most of the last seven years, including 2000. The cause of the changes in DO levels is unknown, however, previous changes in sampling location could account for some of the past increase. Other constituents of concern such as TSS have remained fairly steady in the effluent; influent TSS levels had increased during 1991 due to improved sampling methodology but have remained fairly steady since that time. The BOD₅ effluent average during 2000 (144 mg/L) was higher than that seen during prior years. However, BOD₅ levels in both the influent and effluent have shown a slight upward trend as a result of greater industrial contributors

Table 25. Historical Discharge Monitoring Data (1986-Present) for Influent and Effluent Non-Metals. Values represent average (Avg) or monthly minimum (Min) and maximum (Max) for 1995-1999 (program years running Nov. - Oct.) or a range of the results for years 1986-1994 as available. Results for 2000 include Avg., Min. or Max. of 12 monthly values (Jan. - Dec.).

Year	Temperature (°C)		pH*		Total Residual Chlorine (mg/L)		DO (mg/L)		BOD ₅ (mg/L)		Total Susp. Solids (mg/L)		Fecal Coliform (FC/100 mL)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
1986-1989 Min	9	9	6.4	6.4	NA	0.6	NA	2.1	98	69	117	39	NA	5
1986-1989 Max	17	18	8.0	8.5	NA	1.0	NA	8.6	294	132	286	86	NA	726
1995 Avg	13	13	6.7-8.0	6.3-7.7	NA	0.8	NA	6.7	253	110	247	49	NA	38
1995 Min	10	10	NA	NA	NA	0.7	NA	6.0	200	87	194	45	NA	19
1995 Max	16	16	NA	NA	NA	0.9	NA	7.3	296	129	275	56	NA	79
1996 Avg	12	13	7.0-7.7	6.9-7.5	NA	0.8	NA	6.6	242	106	245	49	NA	31
1996 Min	10	10	NA	NA	NA	0.7	NA	6.1	206	86	214	44	NA	8
1996 Max	15	16	NA	NA	NA	0.9	NA	7.8	262	117	282	54	NA	106
1997 Avg	12	13	7.0-7.7	6.9-7.5	NA	0.9	NA	6.3	243	111	260	48	NA	60
1997 Min	10	10	NA	7.5	NA	0.8	NA	5.8	225	99	228	43	NA	19
1997 Max	16	16	NA	7.9	NA	0.9	NA	7.0	277	132	307	53	NA	179
1998 Avg	12	13	6.4-7.9	6.5-7.9	NA	0.8	NA	6.2	236	108	251	50	NA	23
1998 Min	10	11	NA	NA	NA	0.8	NA	5.6	184	91	204	44	NA	12
1998 Max	15	15	NA	NA	NA	0.9	NA	6.7	272	121	292	55	NA	44
1999 Avg	12.6	13.0	6.5-7.8	6.7-7.9	NA	0.8	NA	6.0	237	118	241	47	NA	71
1999 Min	10.3	10.5	NA	NA	NA	0.7	NA	4.8	203	102	217	41	NA	20
1999 Max	15.6	16.3	NA	NA	NA	0.9	NA	6.9	265	128	270	52	NA	201
2000 Avg	12.7	13.1	6.8-8.2	6.6-8.0	NA	0.8	NA	5.6	243	135	257	46	NA	83
2000 Min	10.4	10.8	NA	NA	NA	0.7	NA	4.5	209	124	220	39	NA	9
2000 Max	15.2	15.6	NA	NA	NA	0.8	NA	6.4	273	144	295	52	NA	252

* Values represent yearly pH minimum and maximum

NA Not applicable

(e.g., fish processors) over the course of the program. The yearly average effluent fecal coliform bacteria concentration reported at 83 MPN/100 mL for 2000 was within the range of that historically seen on the program.

In summary, effluent monitoring indicated that, with the exception of fecal coliform, concentrations of toxic pollutants and pesticides, metals and cyanide, and conventional parameters were much lower than their applicable permit limits or the MAECs. Fecal coliform exceeded permit maximum concentration limits during two months of the 2000 program, but the geometric mean limitation was met for all months. In addition, all toxic pollutants and pesticides concentrations (including metals and cyanide) were lower than or within the range of those detected at secondary treatment plants from across the nation.

5.1.2 Sludge Monitoring

The 2000 permit requires sludge monitoring twice per year, once during the dry conditions in summer and once during wet conditions as noted above. However, there are no Part 503 monitoring requirements included in the reissued permit. Rather, the sludge monitoring is required because the Part 503 regulations are self-implementing as described in Section 2.1.5. Therefore, monitoring at the Point Woronzof plant includes Part 503 monitoring of sludge. The Part 503 monitoring report for the year 2000 will be submitted to EPA as required by 19 February 2000.

While limits for levels of toxic pollutants and pesticides in sludge are not part of the 2000 permit, comparisons can be made for these data based on other treatment facilities' monitoring results. Again, data indicate that concentrations of toxic pollutants and pesticides in Anchorage sludge are generally lower than "typical" concentrations seen at other treatment facilities (Table 26). Unlike last year, the arsenic concentrations seen in sludge were less than those typically seen, with an average of 3.6 µg/g from the Part 503 monitoring as compared to a typical concentration of 4.6 µg/g. June 2000 and August 2000 values also fell below the typical concentration for arsenic. The average mercury concentration in sludge for the 2000 reporting year was slightly over the typical concentration of 1.49 µg/g at 1.6 µg/g, but well below the 95th percentile concentration of 5.84 µg/g. The selenium value reported for the sludge sample during the August 2000 sampling event was 1.5 µg/g as compared to the typical concentration of 1.11 µg/g and a 95th percentile concentration of 4.848 µg/g for this metal.

Table 27 provides an overview of historical sludge data for total metals and cyanide. In general, year 2000 data indicated slightly lowered concentrations of arsenic, cadmium, lead, silver, and cyanide compared to historical data. Values reported in 2000 for copper, mercury, nickel, zinc, and chromium (total) were generally the same as those reported in the past. Beryllium values appeared slightly elevated this year compared to historical averages. Individual measurements, however, were within historical values with a maximum of 0.19 mg/Kg (or µg/g) seen in 2000. These values still fell well below the typical and 95th percentile concentrations reported for beryllium at 0.313 and 1.168 mg/Kg.

Table 26. Comparison Between Sludge Analysis Results for Anchorage and Typical and Worse Case Concentrations Used by EPA in Developing Median or Mean Environmental Profiles^a. All concentrations are in µg/g dry weight.

Pollutant	2000 Anchorage Values			Typical Concentration	95 th Percentile "Worse Case"
	June ^b	August ^b	2000 AVG ^c		
Aldrin/Dieldrin	ND(0.021)	ND(0.024)	---	0.07	0.81
Arsenic	4.4	4.2	3.6 ^c	4.6	20.77
Benzene	ND(0.68)	ND(0.78)	---	0.326	6.58
Benzo(a)anthracene	ND(9.1)	ND(52)	---	0.68	4.8
Benzo(a)pyrene	ND(9.1)	ND(52)	---	0.14	1.94
Beryllium	0.29	0.15	0.13 ^c	0.313	1.168
Bis(2-ethylhexyl)phthalate	ND(9.1)	ND(52)	---	94.28	459.25
Cadmium	2.7	2.9	2.5 ^c	8.15	88.13
Carbon Tetrachloride	ND(0.68)	ND(0.78)	---	0.048	8.006
Chlordane (α,γ)	0.050/0.042	ND(0.024)/0.030	---	3.2	12
Chloroform	ND(0.68)	ND(0.78)	---	0.049	1.177
Chromium	22	23	22 ^c	230.1	1499.7
Copper	174	307	243 ^d	409.6	1427
Cyanide	0.7	0.9	0.5 ^d	476.2	2686.6
DDT/DDE/DDD	ND(0.008)/ND(0.008)/0.012	0.016/ND(0.0091)/0.25	---	0.28	0.93
3,3-Dichlorobenzidine	ND(44)	ND(250)	---	1.64	2.29
Methylene chloride	ND(0.68)	ND(0.78)	---	1.6	19
Endrin	ND(0.042)	ND(0.049)	---	0.14	0.17
Hexachlorobenzene	ND(9.1)	ND(52)	---	0.38	2.18
Hexachlorobutadiene	ND(9.1)	ND(52)	---	0.3	8
Lead	28	53.4	37 ^c	248.2	1070.8
gamma -BHC (Lindane)	ND(0.021)	ND(0.024)	---	0.11	0.22
Malathion	ND(0.053)	ND(0.061)	---	0.045	0.63
Mercury	0.7	2.3	1.6 ^c	1.49	5.84
Nickel	21	25	21 ^c	44.7	662.7
PCBs	ND(0.42)	ND(0.49)	---	0.99	2.9
Pentachlorophenol	ND(44)	ND(250)	---	0.0865	30.434
Phenanthrene	ND(9.1)	ND(52)	---	3.71	20.69
Phenol	ND(9.1)	ND(52)	---	4.884	82.06
Selenium	0.61	1.5	---	1.11	4.848
Tetrachloroethene	ND(0.68)	ND(0.78)	---	0.181	13.707
Trichloroethene	ND(0.68)	ND(0.78)	---	0.46	17.85
2,4,6-Trichlorophenol	ND(9.1)	ND(52)	---	2.3	4.6
Vinyl Chloride	ND(1.4)	ND(1.6)	---	0.43	311.942
Zinc	337	633	470 ^d	677.6	4580

^a Source: EPA 1985c. *Summary of Environmental Profiles and Hazard Indices for Constituents of Municipal Sludge: Methods and Results*. Office of Water Regulations and Standards, Appendix F.

^b Data from NPDES 2000 toxic pollutant and pesticide monitoring

^c Average from 2000 Part 503 sludge monitoring results

^d Average from available monthly in-plant monitoring results

--- Not monitored in-plant

ND () Not detected (detection limit)

NT Not tested

Table 27. Historical Discharge Monitoring Data (1986 - Present) for Sludge Metals and Cyanide. Concentrations are in mg/kg dry weight. Values represent average (Avg) or monthly minimum (Min) and maximum (Max) for 1995-1999 (program years running Nov. - Oct.) or a range of the results for years 1986-1994 as available. Results for 2000 include Avg., Min. or Max. of seven monthly values (Jan. - July) and Part 503 monitoring values if available (two or three results in Aug. - Dec. 2000).

Year	Arsenic	Beryllium*	Cadmium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Chromium (Total)	Cyanide (Total)
1986-1994 Min	1.7	0.05	1.2	190	36	<0.1	<8	6.4	121	3.38	0.07
1986-1994 Max	151	0.20	10.0	532	468	7.3	42	110	920	37	5.18
1995 Avg	14.6	0.11	4.4	265	124	1.4	19	29.2	554	24	1.35
1995 Min	3.4	<0.02	2.6	221	45	0.7	13	18.7	438	16	0.9
1995 Max	50	0.20	9.8	314	324	1.9	28	41.4	738	38	2.0
1996 Avg	11.2	0.12	3.6	249	62	1.7	18	25.4	548	27	1.79
1996 Min	5.2	0.07	2.4	189	49	0.8	15	3.6	395	20	1.14
1996 Max	31.7	0.22	4.7	308	104	3.3	26	65.4	723	48	2.19
1997 Avg	9.4	0.11	3.7	268	60	1.4	22	23.8	547	21	1.43
1997 Min	5.0	<0.02	1.4	197	32	0.2	14	3.4	415	13	0.84
1997 Max	20.4	0.19	5.1	385	80	2.8	27	44.7	756	26	1.99
1998 Avg	18.0	0.10	3.0	229	70	1.5	18	26.4	485	20	1.73
1998 Min	3.6	0.07	0.7	176	33	0.7	11	7.2	392	5	0.58
1998 Max	135.8	0.14	5.2	276	294	2.9	26	80.5	655	55	<3.0
1999 Avg	9.1	0.11	2.9	247	46	1.9	20	24.1	487	21	0.50
1999 Min	2.2	0.02	1.1	154	32	0.9	10	17.2	288	12	0.24
1999 Max	36.1	0.18	5.2	309	88	4.0	28	47.1	605	28	1.00
2000 Avg	3.6	0.13	2.5	243	37	1.6	21	19	470	22	0.50
2000 Min	2.1	0.09	1.8	204	24	0.8	12	1.8	402	12	0.20
2000 Max	4.8	0.19	3.2	307	53	3.2	27	29	633	49	0.90

* Beryllium testing began in 1993

5.2 WATER QUALITY MONITORING

5.2.1 Plume Dispersion Sampling

To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, the non-parametric Kruskal-Wallis Test (Zar, 1984) was employed which determined whether significant differences occurred within the sample group. If significant differences were observed, Dunn's test, a test that performs pair-wise tests of significance ($\alpha = 0.05$), was employed (Dunn, 1964). The results of these tests for the August survey period as a function of water quality parameters are presented in Table 28. Non-detect values were replaced with the detection limit value for statistical testing.

Data from the receiving water survey showed no statistically significant difference between outfall and control stations for temperature, salinity, DO, or turbidity at surface, mid-, and bottom sampling depths. While not seen in 1998-2000 data, the salinities at the control stations had historically been lower than those at the outfall stations due to the control stations being located closer to sources of freshwater input. In addition, the temperatures at the control stations had historically been lower than those at the outfall, most likely due to the influence of colder freshwater inputs near the control stations.

No statistically significant differences were noted between outfall and control stations in terms of color or TRC results. These parameters are only tested at the surface and were similar across most stations.

Statistical analyses indicated significant differences between some station groups at surface, mid-, and bottom depths for pH. Review of the data show that the pH at the control stations were slightly lower than those at the nearfield outfall stations. No statistical differences were noted between the within-ZID and any other station grouping. In addition, the range of pH values at all stations was very small, so this parameter is not of concern in terms of the discharge from Point Woronzof. The pH values fell within the AWQS of 6.5 - 8.5 and did not vary more than 0.2 pH units. It is likely that, as in the past, very small differences in pH can be attributed to the natural variability in the two water masses being sampled, even though these differences were not apparent this year in salinity or temperature.

Fecal coliform samples collected at the surface did show statistical differences between the control and outfall stations. See Section 5.2.2 below for a full discussion of fecal coliform data in terms of both hypothesis testing and state water quality standards.

In addition to the standard water quality sampling, concentrations of total polynuclear aromatic hydrocarbons, total aromatic hydrocarbons as BETX, and TAqH were measured at the surface at six stations (three at the flood tide control site and three at the flood tide outfall site). These parameters were found to be below detection limits at all stations, therefore no significant differences were found between the control and outfall station groups for any of these parameters.

Total suspended solids and total recoverable and dissolved metals samples collected at the outfall and control sites were also subject to statistical testing. No significant differences between locations were noted for TSS or any of the total recoverable or dissolved metals.

Table 28. Significant Station Pairs at the 5% Significance Level Using the Kruskal-Wallis and Dunn's Tests.

Parameter	Sample Depth		
	Surface	Middle	Bottom
Temperature*	NS	NS	NS
Salinity*	NS	NS	NS
Dissolved Oxygen*	NS	NS	NS
pH*	3,4	3,4	2,4 / 3,4
Turbidity*	NS	NS	NS
Color Units*	NS	----	----
Fecal Coliform*	1,4 / 2,4 / 3,4	----	----
Total Residual Chlorine*	NS	----	----
Arsenic**	NS ^D ,NS ^{TR}	----	----
Cadmium**	NS ^D ,NS ^{TR}	----	----
Chromium**	NS ^D ,NS ^{TR}	----	----
Copper**	NS ^D ,NS ^{TR}	----	----
Mercury**	NS ^D ,NS ^{TR}	----	----
Nickel**	NS ^D ,NS ^{TR}	----	----
Lead**	NS ^D ,NS ^{TR}	----	----
Silver**	NS ^D ,NS ^{TR}	----	----
Zinc**	NS ^D ,NS ^{TR}	----	----
Cyanide**	NS	----	----
Total Suspended Solids**	NS	----	----
Total Aromatic Hydrocarbons (EPA 602)**	NS	----	----
Total Aqueous Hydrocarbons (TAqH)**	NS	----	----

* Statistics performed on Group 1: Within-ZID Stations; Group 2: ZID Boundary Stations; Group 3: Nearfield Stations; and Group 4: Control Stations.

** Statistics performed on stations along outfall Drogue F1 versus the control, Drogue C1.

---- Not Applicable (surface samples only)

NS Not Significant

SIG Significant

^D Dissolved

^{TR} Total Recoverable

A comparison of the water quality data listed in Table 15 with the marine receiving water quality for the State of Alaska (Tables 21 and 29) indicates that with the exception of color, none of the parameters listed in Table 15 exceeded the State's standards. Most color values were at or below the state-specified limit of 15 color units, but 20 color units was seen once at the control station (C1-1) and twice at the flood stations (F1-1 and F1-2). Given that this exceedance occurred at the control site as well as the outfall stations, it is unlikely that the increased color values are ascribable to the outfall. It is more likely that these elevated values are a turbidity issue. These values are anomalously high given historical data; color values last year ranged from <5 to 10 color units at all stations, with the maximum value of 10 color units seen at one within-ZID outfall station (F1-1).

The State's receiving water quality standard for the "growth and propagation of fish, shellfish, aquatic life, and wildlife including seabirds, waterfowl, and furbearers" is 15 µg/L for TAqH and 10 µg/L for total aromatic hydrocarbons as BETX. As seen in Table 17, these standards were met. For both the control and outfall stations, these parameters were reported as not detected, with method detection limits well below the state standards. In addition, for "contact recreation", the AWCs for hydrocarbons is as follows: "Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils." No film, sheen, or discoloration was observed during the receiving water program in 2000.

All the dissolved metals tested in receiving water (Table 16) as part of this program met the AWCs criteria as shown in Table 21. This included arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. Testing of antimony, beryllium, selenium, and thallium in receiving water is not required by the permit and was not performed this year. Previous years of the monitoring program showed exceedences of water quality criteria for total metals that were due to the specified test methods in conjunction with high amounts of suspended particulates in Cook Inlet. Since the adoption of the more-appropriate SSWC for dissolved metals in May 1999, the receiving waters of Cook Inlet near the Point Woronzof discharge have been in compliance with the AWCs.

Cyanide samples met State-specified criteria of 2 µg/L which is the water quality standard for marine aquatic life. Cyanide samples collected during the receiving water sampling were all below the detection limit of 2 µg/L.

In summation, statistical analyses of the 2000 receiving water quality data indicated that water quality outside the ZID was not degraded with respect to control stations for most parameters. Differences that were noted in pH were unlikely to be influenced by the Point Woronzof outfall. With the exception of color, all AWCs were met for the Point Woronzof receiving water quality program. Elevated color values were seen at some control and outfall stations but this was not attributed to the outfall.

5.2.2 Fecal Coliform Bacteria

The ADEC has indicated that one of their primary concerns is bacterial contamination of the shoreline by the Point Woronzof discharge, indicated by fecal coliform bacteria concentrations. Because the Knik Arm's water uses have not been classified, regulations provide that the most restrictive standard must apply. State marine water quality standards (18 AAC 70 as amended through May 27, 1999) for contact recreation require that the geometric mean fecal coliform concentration taken within a 30-day period not exceed 100 MPN/100 mL and that not more than one

Table 29. State of Alaska Water Quality Standards for Receiving Water.

Parameter		Most Restrictive Marine Water Quality Standards	
Fecal Coliform	Based on a 5-tube decimal dilution test the fecal coliform median MPN shall not exceed 14 FC/100 mL (harvesting for consumption of raw shellfish); a geometric mean of 20 FC/100 mL (for aquaculture of products not normally cooked and seafood processing); and not more than ten percent (10%) of the samples shall exceed 40 FC/100 mL (aquaculture of products not normally cooked and seafood processing).		
Dissolved Oxygen	Dissolved oxygen concentrations in estuaries and tidal tributaries shall not be less than 5.0 mg/L except where natural conditions cause this value to be depressed.		
pH	pH shall not be less than 6.5 or greater than 8.5, and shall not vary more than 0.2 pH unit from natural condition.		
Turbidity	Turbidity may not exceed the natural condition.		
Temperature	Temperature shall not cause the weekly average temperature to increase more than 1° C. The maximum rate of change shall not exceed 0.5° C per hour. Normal daily temperature cycles shall not be altered in amplitude or frequency.		
Salinity	Maximum allowable variation above natural salinity:		
		Natural Salinity (‰)	Man-induced Salinity (‰)
		0 to 3.5	1
		3.5 to 13.5	2
		13.5 to 35.0	4
Sediment	No measurable increase in concentrations above natural conditions.		
Color	Color shall not exceed 15 color units.		
Petroleum Hydrocarbons, Oils and Grease	Total aqueous hydrocarbons (TAQH) in the water column shall not exceed 15 µg/L. Total aromatic hydrocarbons in the water column shall not exceed 10 µg/L. Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils.		
Total Residual Chlorine	Concentrations shall not exceed 2.0 µg/L for salmonoid fish or 10.0 µg/L for other organisms.		
Toxic and Other Deleterious Substances	See Table 21.		

sample or more than ten percent of the samples if there are more than ten exceed 200 MPN/100 mL. Criteria for secondary recreation and for industrial water supply require that the mean fecal coliform concentration not exceed 200 MPN/100 mL and that not more than ten percent of the samples exceed 400 MPN/100 mL. State marine water quality criteria for the harvesting for consumption of raw mollusks and other raw aquatic life require that, based on a 5-tube decimal dilution test, the median shall not exceed 14 MPN/100 mL and that not more than ten percent of the samples shall exceed 43 MPN/100 mL. For seafood processing water supply for products not normally cooked, criteria are that the geometric mean may not exceed 20 MPN/100 mL and not more than ten percent of the samples exceed 40 MPN/100 mL, and 200 and 400 MPN/100 mL for products normally cooked, respectively. For aquaculture water supply, criteria are that the geometric mean may not exceed 20 MPN/100 mL and not more than ten percent of the samples exceed 40 MPN/100 mL.

Since the harvesting of shellfish and other raw aquatic life is not performed in these waters and there is no aquaculture or seafood processing, it seems that the criteria for secondary recreation is most applicable; however, these criteria are not the most restrictive. Therefore, the most restrictive criteria used were that the median shall not exceed 14 MPN/100 mL (consumption of raw shellfish and other aquatic life), the geometric mean shall not exceed 20 MPN/100 mL (seafood processing and aquaculture for raw consumption), and not more than ten percent shall exceed 40 MPN/100 mL (seafood processing and aquaculture for raw consumption; Table 29).

Statistical tests indicated that fecal coliform concentrations were significantly higher at the within-ZID, ZID boundary and the nearfield station groups as compared to the control stations (refer to Table 28). Fecal coliform concentrations values ranged from <2.0 to 130 MPN/100 mL at the outfall stations compared to range of <2.0 to 7.0 MPN/100 mL at the control stations. The median at the control site was 2.0 MPN/100 mL, versus 7.0 MPN/100 mL at the outfall stations, well below the criterion of 14 MPN/100 mL. The control site had a geometric mean of 2.3 MPN/100 mL, while that at the outfall stations was 6.0 MPN/100 mL, again well below the criteria of 20 MPN/100 mL. Only one value out of 24 measurements (4.2 %) at the outfall stations exceeded 40 MPN/100 mL, compared to the criteria of not more than 10 percent of the measurements may exceed 40 MPN/100 mL. This one relative high fecal coliform value of 130 MPN/100 mL was at a station located within the ZID directly over the outfall at low slack water and was not subject to the water quality standards since it was measured within the ZID.

Slightly elevated values seen at the outfall stations may be influenced by the Point Woronzof discharge; however, it is important to note area creeks most likely impact the bacterial counts in the Point Woronzof area as well. As in the past, extremely high fecal coliform bacterial concentrations were seen in the three creeks sampled. Replicate concentrations measured in Chester Creek were 30 and 130 MPN/100 mL, in Fish Creek were 1600 and 1600 MPN/100 mL, and in Ship Creek were 4 and 30 MPN/100 mL. Further evidence of the creeks' potential contributions to elevated offshore bacterial counts is supported by the fact that the nearfield station values were also significantly higher than that seen at the controls for fecal coliform.

The range of fecal coliform concentrations for all intertidal samples collected during 2000 was 2.0 to 30.0 MPN/100 mL, with a median of 5.5 FC 100 mL and a geometric mean of 6.4 MPN/100 mL. This is compared to the most restrictive water quality criterion of a median of 14 MPN/100 mL and a geometric mean of 20 MPN/100 mL. The two highest coliform concentrations were 30.0 MPN/100 mL reported at Stations IT-1 located 2000 m south of Point Woronzof and the outfall and

23.0 MPN/100 mL measured at the control site across Cook Inlet. Differences between field replicates was fairly high and was probably due to natural variability. Some of these slightly elevated intertidal concentrations may be the result of heavy waterfowl use of the area (refer to Figure 3 for station locations). The criterion of not more than 10% of the samples exceeding 40 FC 100/mL was clearly met, as none of the samples exceeded this value. The fecal coliform concentrations in the effluent samples collected in conjunction with the receiving water, intertidal station, and stream sampling was reported at 500 MPN/100 mL for both replicates.

In summary, elevated fecal coliform concentrations in the Point Woronzof area, although significantly different within the mixing zone, ZID-boundary, and nearfield stations as compared to the control, could not be directly attributed to only the Point Woronzof outfall. Area creeks again showed the highest fecal coliform concentrations compared to the intertidal or receiving water stations, indicating that receiving water concentrations may be influenced by runoff from these creeks. Fecal coliform samples collected during both the receiving water and intertidal sampling programs met the most restrictive receiving water standards. The median of the intertidal samples was less than the State-specified limit of 14 MPN/100 mL, the geometric mean was less than 20 MPN/100 mL, and the criterion of not more than 10% of the samples exceeding 40 FC 100/mL was met.

6.0 CONCLUSIONS

The following conclusions were based on results from this year of monitoring as compared to the new 2000 NPDES permit:

- The influent, effluent, and sludge monitoring has shown that, with the exception of only one parameter, the Point Woronzof facility is meeting the 2000 NPDES permit requirements and is complying with State of Alaska water quality standards. MOA's self-monitoring of pH, total residual chlorine, BOD₅, and TSS showed compliance with all 2000 permit effluent limitations.
- Fecal coliform exceeded the monthly criteria "that not more than 10% of the effluent samples shall exceed 2600 FC MPN/100 mL during any month" during July and October 2000. However, the maximum geometric mean of 850 FC MPN/100 mL was never exceeded.
- Percent removals for BOD₅ (44%) and TSS (82%) were considerably better than the 30% required by the amendment to the Clean Water Act (40 CFR Part 125; Final Rule, 8/9/94).
- Total aqueous hydrocarbon and total aromatic hydrocarbon concentrations in the effluent were below their respective MAECs.
- Cyanide and metals concentrations in the effluent never exceeded their MAECs during any of the monthly or toxic pollutant samplings.
- Concentrations of toxic pollutants and pesticides, including metals and cyanide, in influent and effluent were within the established range or lower than values from a national study of secondary treatment plants. Toxic pollutant sludge concentrations were within the established range or lower than values from a national study of secondary treatment plants.
- Whole effluent toxicity testing conducted on three species during the last two quarters of 2000 under the 2000 permit met the permit limitations for chronic toxicity. The most sensitive species during these two test periods was shown to be the mussel *Mytilus galloprovincialis*.
- To test the hypothesis that the water quality at the ZID boundary was not degraded with respect to the water quality at the nearfield and control stations, statistical comparisons were employed. With the exception of pH and fecal coliform, no statistically significant differences were found. Fecal coliform concentrations were significantly higher within the ZID, at the ZID boundary, and at the nearfield stations as compared to the control stations. These differences could not be directly attributed only to the Point Woronzof discharge. Local creeks exhibited fecal coliform concentrations higher than most of the water quality and intertidal stations.
- Fecal coliform concentrations in receiving water and intertidal samples met the State-specified criteria of a median of 14 MPN/100 mL, a geometric mean of 20 MPN/100 mL, and of not more than 10 percent of the samples exceeding 40 MPN/100 mL.

- Supplemental receiving water quality samples obtained as part of the plume dispersion monitoring indicated that background levels of dissolved metals were all below the new State site-specific water quality standards. Total recoverable metals were elevated compared to the dissolved, as expected, and this was attributed to high suspended sediment loads. No significant differences between the outfall and control stations were found for either dissolved or total recoverable metals. All cyanide concentrations were below detection limits.
- Supplemental receiving water samples also indicated that total aromatic hydrocarbons and total aqueous hydrocarbons did not exceed the State's water quality standard at any outfall or control station. Concentrations were all below detection limits, and no significant differences were found between concentrations at the control and outfall stations.
- Turbidity and total residual chlorine met the State water quality criteria at all stations. Color exceeded the State water quality criterion at a number of stations, including both outfall and control stations, and therefore this was not attributed to the outfall.

CONCLUSIONS

Results from this year of the monitoring program confirm previous studies, data in the 301(h) waiver application, and the decision by the EPA to reissue the permit. The Point Woronzof facility is operating within regulatory requirements with only one exception and with no significant impacts to the marine environment.

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